IGOR WITKOWSKI

DIE WAHRHEIT ÜBER DIE WUNDERWAFFE

TEIL 1

GEHEIME WAFFEN-TECHNOLOGIE IM DRITTEN REICH

Igor Vitkovsky
The truth about the miracle weapon

Title of the original edition: "Pravda o Wunderwaffe"

German first edition, 2008

German translation: Marek Kosmala, Björn Moritz
Cover graphic: Tomasz Maros
Layout: Inna Kralovyetts

Mosquito Verlag

www.mosquito-verlag.de

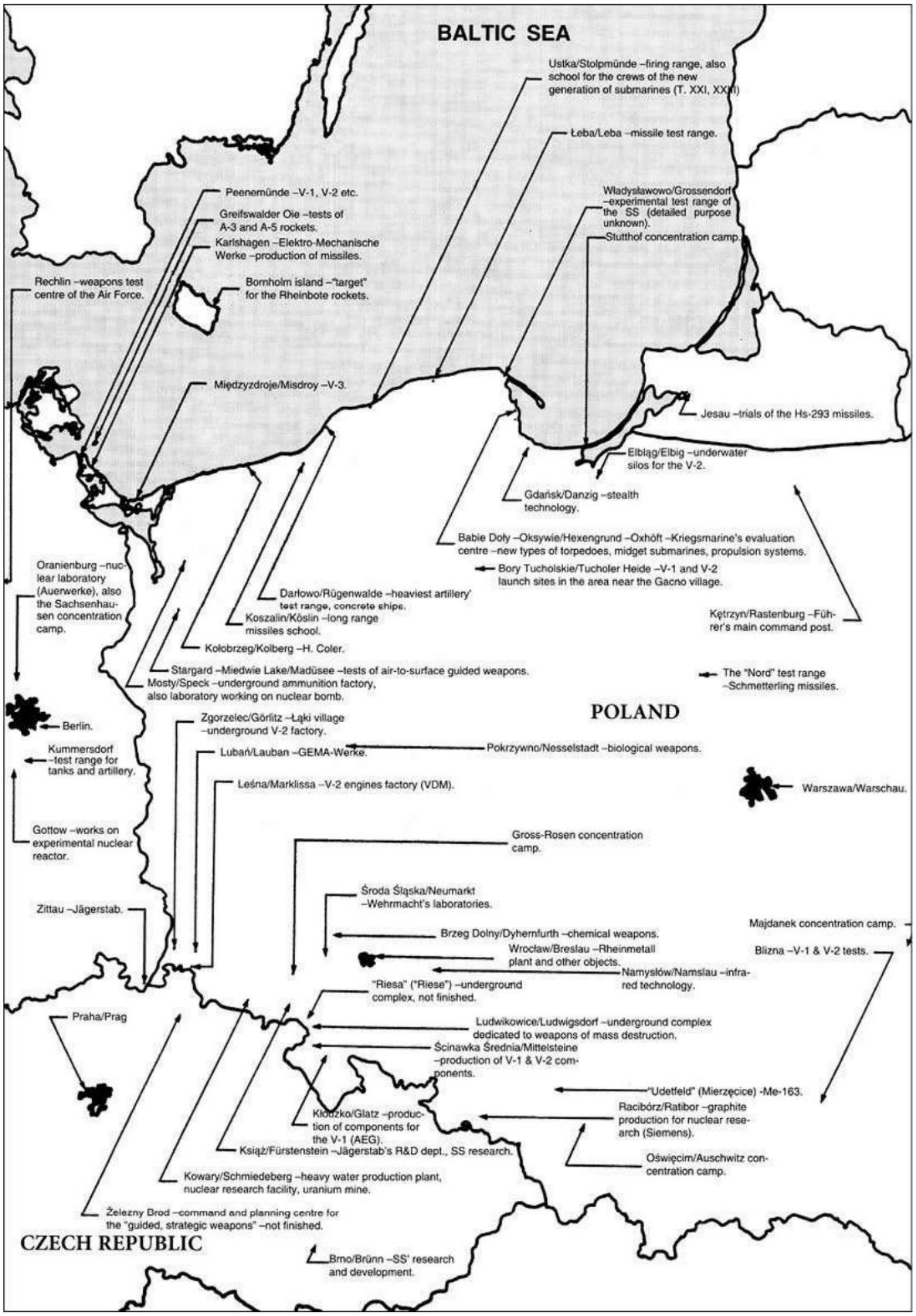
IGOR WITKOWSKI

THE TRUTH ABOUT THE MIRACLE WEAPON

Secret weapon technology in the Third Reich

Part 1

Defense technical turning point of the weapons


BALTIC SEA
Ustka/Stolpmünde –firing range, also school for the crews of the new generation of submarines (T. XXI, XXIII)
Łeba/Leba –missile test range.
Władysławowo/Grossendorf –experimental test range of the SS (detailed purpose unknown).
Stutthof concentration camp.
Peenemünde –V-1, V-2 etc.
Greifswalder Oie –tests of A-3 and A-5 rockets.
Karlshagen –Elektro-Mechanische Werke –production of missiles.
Rechlin –weapons test centre of the Air Force.
Bornholm island –"target" for the Rheinbote rockets.
Międzyzdroje/Misdroy –V-3.
Jesau –trials of the Hs-293 missiles.
Elbląg/Elbig –underwater silos for the V-2.
Gdańsk/Danzig –stealth technology.
Babie Doły –Oksywie/Hexengrund –Oxhöft –Kriegsmarine's evaluation centre –new types of torpedoes, midget submarines, propulsion systems.
Bory Tucholskie/Tucholer Heide –V-1 and V-2 launch sites in the area near the Gacno village.
Oranienburg –nuclear laboratory (Auerwerke), also the Sachsenhausen concentration camp.
Darłowo/Rügenwalde –heaviest artillery' test range, concrete ships.
Koszalin/Köslin –long range missiles school.
Kętrzyn/Rastenburg –Führer's main command post.
Kołobrzeg/Kolberg –H. Coler.
Stargard –Miedwie Lake/Madüsee –tests of air-to-surface guided weapons.
Mosty/Speck –underground ammunition factory, also laboratory working on nuclear bomb.
The "Nord" test range –Schmetterling missiles.
POLAND
Berlin.
Zgorzelec/Görlitz –Łąki village –underground V-2 factory.
Kummersdorf –test range for tanks and artillery.
Lubań/Lauban –GEMA-Werke.
Pokrzywno/Nesselstadt –biological weapons.
Leśna/Marklissa –V-2 engines factory (VDM).
Warszawa/Warschau.
Gottow –works on experimental nuclear reactor.
Gross-Rosen concentration camp.
Środa Śląska/Neumarkt –Wehrmacht's laboratories.
Zittau –Jägerstab.
Majdanek concentration camp.
Brzeg Dolny/Dyhernfurth –chemical weapons.
Blizna –V-1 & V-2 tests.
Wrocław/Breslau –Rheinmetall plant and other objects.
Namysłów/Namslau –infrared technology.
"Riesa" ("Riese") –underground complex, not finished.
Praha/Prag
Ludwikowice/Ludwigsdorf –underground complex dedicated to weapons of mass destruction.
Ścinawka Średnia/Mittelsteine –production of V-1 & V-2 components.
"Udetfeld" (Mierzęcice) -Me-163.
Kłodzko/Glatz –production of components for the V-1 (AEG).
Racibórz/Ratibor –graphite production for nuclear research (Siemens).
Książ/Fürstenstein –Jägerstab's R&D dept., SS research.
Oświęcim/Auschwitz concentration camp.
Kowary/Schmiedeberg –heavy water production plant, nuclear research facility, uranium mine.
Żelezny Brod –command and planning centre for the "guided, strategic weapons" –not finished.
CZECH REPUBLIC
Brno/Brünn –SS' research and development.

introduction

The most secret and technically advanced weapons of the Third Reich are a complex subject that forces us to think in very different ways. These considerations relate both to the structure of the armaments industry and to science itself, to the barbaric plan to return to slavery, and even to the role of the SS in the overall system of the war economy. Although this book is devoted exclusively to technical issues, it is worthwhile to become aware of these larger connections. It is not a purely historical problem; the conclusions that emerge from the considerations are timeless and could also be important for the future. If we focus on the technical issues, a dominant feature of the whole scientific and economic system becomes apparent: its incredible efficiency. This feature is often interpreted and presented as a kind of "trump card" of National Socialism. This is not only a fallacy, however, but also a convenient escape from a factual analysis of the facts.

I cannot in any way justify such conclusions, which can only have come about through superficial considerations. While evaluating how science and economy functioned in the Third Reich, I did not come across any arguments or circumstances that would confirm these assumptions. I have the feeling that technical progress was not brought about *by* fascism, but *in spite* of its dominance. Hitler once said: "I don't want an intellectual education. I spoil my youth with knowledge."

The only typical Nazi element that appeared in the Hitler-controlled system and left its mark on the organization of science and technology was the party. However, it did not encourage any particular constructiveness - quite the contrary: the blind terror and ignorance of the unscrupulous, incompetent rulers who were endowed with excessive power are incompatible with such a claim.
Not only victims of the system shared this view, but also many

Employees of the Reich Ministry for Armaments and War Production headed by Defense Minister Albert Speer. In the NARA archives I found the report of a post-war interrogation of Kurt Weissenborn, the head of the weapons department in Speer's ministry. He described the influence of the "ideological element" on the war economy as follows:

Albert Speer and Field Marshal Erhard Milch. (Photo: Bundesarchiv Koblenz)

"... a strange 'Mitropa' train is waiting at the Potsdam station under steam. The third car is the restaurant. It is the train *Hubertus,* owned by party member Saur - the head of the Technical Department in the Ministry of Armaments and War Production of the Third Reich. Engineers and industrialists of all kinds, as well as civil servants from Speer's ministry, have been sitting on this train for half an hour. Then a small man with the tight 'ascetic' face typical of those puffed-up brown shirts rushes through the cordon, followed by members of his personal staff. The train departs. Like a storm it attacks the centers of the armaments industry. Saur's engineering staff charges through the factory workshops, with himself in the lead. He brandishes his weapon and screams in his piercing, sometimes cracking voice. It takes him only a few minutes to dismiss the factory directors, replace the chief engineers and, in the presence of all present, members of his own staff

measure. Along his train's long journey (over which he has all right-of-way), many more engineers and industrialists wait for hours on platforms before finally being let on the train 'for questioning', only to be dismissed like schoolboys again. As soon as the interrogations and interrogations are over, the train driver receives the order by telephone to stop at the next station, and all of a sudden the dismissed people are standing on a strange platform and are watching the departing *Hubertus* train . There wasn't an hour of the day or night when people who had previously waited for hours weren't 'handled' in a matter of minutes. No technical intelligence or top intellectual power was allowed to speak out here - only the brutal treatment of the individual spoke here. Saur introduced a caste system to industry. But the industrial machine, extremely sensitive in other cases, repelled these attacks, trained and learned to endure the Gestapo interrogations and the daily contacts with the party apparatus.

If anyone tried to defend themselves, they were ruthlessly silenced and removed from their post.
If he was young enough, he found himself a soldier the next day. It was not fear of a lack of government contracts, but the fear of each individual for himself and his family that evoked this obedience and allowed even the most degrading treatment to be endured. Saur ruled his zoo in a manorial manner, regularly employing brutal methods.

Karl Otto Saur

I myself have seen 60-year-old engineers burst into tears in front of everyone because they were treated like dogs despite all their day and night toil. At the same time, in the vast majority of cases, the problems were impossible to solve. However, it was all too easy for the incompetent senior technical office to absolve themselves of all responsibility simply by pretending to be innocent."

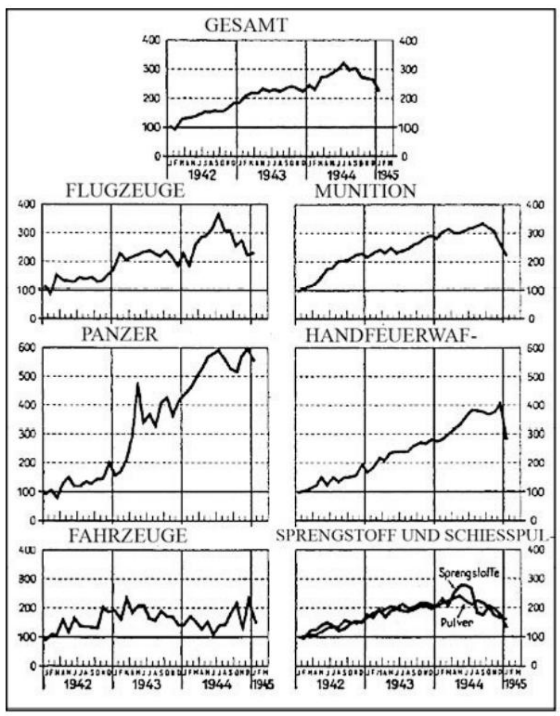
As I have already mentioned, this was the only typical Nazi element in the whole system that exerted its influence in every respect. Of course there was the SS, but the influence of this organization was of a different nature. She made sure that there was enough slave labor available to the economic fabric. It is precisely this factor that undoubtedly played a key role in the rapid and continuous increase in economic output - despite immense supply bottlenecks, an enormous shortage of strategic raw materials and the infernal destruction caused by the Allied air bombardments. Overall, the economy grew three to fourfold, with products becoming more modern. The time of the crisis and at the same time the peak of production fell in the summer of 1944. The contrast between the political situation and the performance of the German economy becomes particularly clear when one considers that the carpet bombing had been falling on Germany since the spring of 1942 and despite this In 1943 almost twice as many aircraft were produced for the Luftwaffe as in the previous year. This development was repeated in the following year 1944 - the corresponding numbers are: 15,409, 24,807 and 40,593 aircraft. This contradiction was best described in the "Memoirs" by Albert Speer, the main person responsible and the undisputed organizational genius of this paradox:

[1]

"Just six months after I took office, we had significantly increased production in all areas assigned to us. August production in 1942 was increased by 27 percent compared to February production for weapons and 25 percent for tanks, while ammunition production almost doubled at 97 percent.

Total armor output increased by 59.6 percent over this period. Obviously we had mobilized reserves that had been idle until then.

After two and a half years we had raised our total armaments production from an average index of 98 in 1941 to a peak of 322 in July 1944, despite the bombing war just beginning. The workforce increased by only about 30 percent. It was possible to reduce the workload by half. We had achieved exactly what Rathenau had predicted in 1917 as a rationalization effect: 'doubling production with the same equipment and the same labor costs.'



Production in the main branches of the German war industry. (Figures from: "German Industry at War...")

Below he writes:

“The exhilaration of the first few months, in which the development of the new organization, the success and the recognition had put me, soon gave way to a time of great concern and growing difficulties. Not only

> These worries applied to the labor problem, unresolved material questions and court intrigues. The bombing raids by the British Air Force and their initial impact on production made me temporarily forget Bormann, Sauckel and Central Planning.
> At the same time, however, they formed one of the prerequisites for my growing prestige. Because despite the losses that occurred, we produced more, not less."

The impact of the concentration camp system on the success of the war industry was significantly less than is commonly believed.
A total of nine million people passed through the camps; obviously only a small part of them was exploited for industry.
Apart from that, these people mostly only worked for a short time, since the tragic living conditions led to an enormous death rate. For these reasons, the effectiveness of such workers was also low.

Nevertheless, the industry could only implement technical achievements that had already been achieved. The key question of this book is therefore not about the organization of the war machine as such.
Rather, we will be interested in various aspects related to the function of science - after all, it was the origin of the most important and significant discoveries from today's point of view. And this science produced really extraordinary things.

We must realize that this period was a period of unimaginable scientific and technological progress. In principle, the technology at the beginning of the Second World War did not differ greatly from the level of technology at the end of the First World War. Let's take a look at aviation: Airplanes, mostly made of wooden components covered with canvas, dominated the field. Only a few years later, however, the first all-metal jet fighters, equipped with radar and guided weapons, appeared.

The way was also paved for the production of supersonic aircraft with an even newer generation of propulsion – for example with the ramjet engine for airplanes or rockets. The concept for vertical take-off and landing fighter jets has been tested in practice (the *engine wings,* the *wasp).* Technologies for improved protection have also been developed

enemy radar researched. Submarines were built that could remain submerged for several weeks at a time, and a variety of navigation (homing) systems based on semiconductor detectors emerged. The material in Part 2 of this book proves that an even further step forward has been taken. Similar developments have also taken place in armored vehicles.

The beginnings of the war took place under the banner of tanks, which served as infantry support and were armed more symbolically.
Its armor was so poor that it could be pierced by a rifle loaded with armor-piercing ammunition. Horses still formed the core of most armies. By the end of the war, it was only a matter of production capacity to put into operation a tank that could be used day and night, had a gun, was powered by petrol, had a hydraulic steering and propulsion system, and had chemical and anti-aircraft defenses equipped with biological weapons

...

Prisoners of a concentration camp in an underground factory. (Photo: Imperial War Museum)

The situation was similar in most other areas.

Technological progress was not only greater than what was observed between the 1920s and 1930s, it was also greater than anything that has taken place in the 50 years since the end of World War II until now! Virtually all modern trends in weapon development were initiated precisely during this period. It seems that this was the greatest technological leap in the history of our civilization -

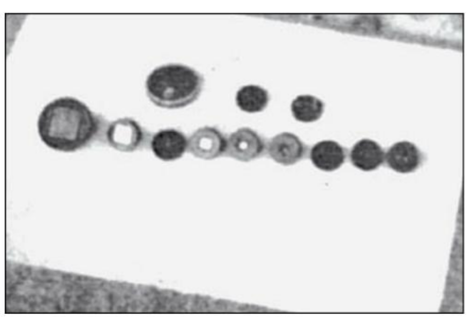
undisputedly a subject that deserves a closer look. The importance of these achievements is evidenced by the enormous volume of German scientific and technical ideas adopted by the USA and USSR after the war (nearly 340,000 patents). Around the end of 2001, I had the opportunity to be one of the first independent researchers to extensively analyze historical documents from the US National Air Intelligence Center at Wright Patterson Air Force Base. Immediately after the war, the headquarters of the technical intelligence service was located there. From discussions with some of the senior base employees, it was clear that after the end of the war, as various German prototypes and designs were being studied and tested, a period of "technological gold rush" ensued in the United States. In the Air Force base documents, I came across a comment by General Hugh Knerr, commander of US forces in Europe in 1945:

2

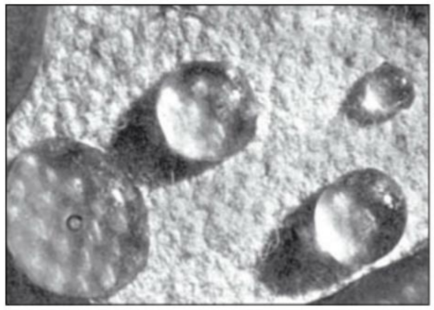
> “The takeover of German scientific and industrial institutions has shown that we are alarmingly behind in many areas of research. If we don't take this opportunity and take advantage of the devices and their inventors, we will be left many years behind while still doing work that has long been accomplished."

President Eisenhower then stated that

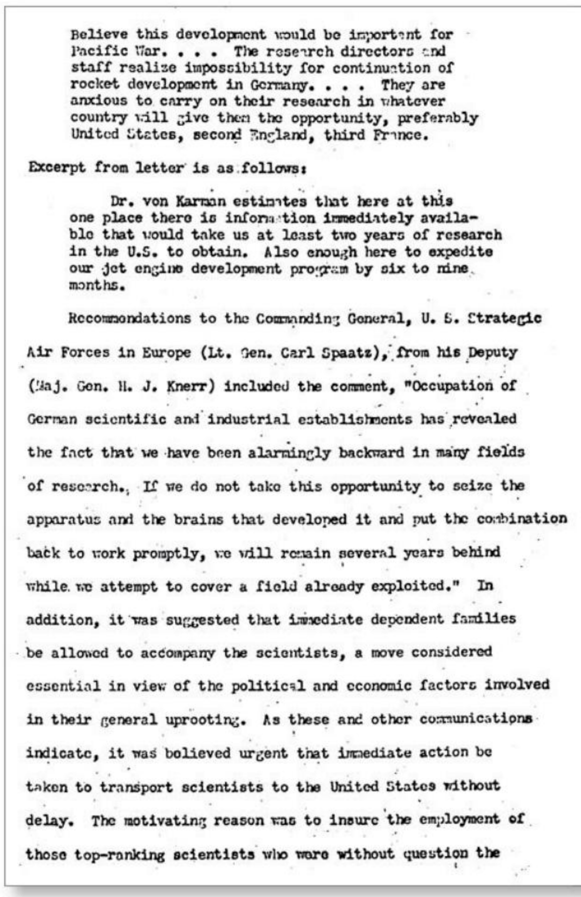
> "... German technology was a good ten years ahead of the Allies. Fortunately, the German commanders took advantage of this superiority and only realized too late what opportunities this would have offered them.”



German infrared semiconductor detectors manufactured during the war. (Photo: CIOS)



Synthetic fibers in the water permeability test. (Photo: IG Farben)



> Believe this development would be important for Pacific War. . . . The research directors and staff realize impossibility for continuation of rocket development in Germany. . . . They are anxious to carry on their research in whatever country will give them the opportunity, preferably United States, second England, third France.

Excerpt from letter is as follows:

> Dr. von Karman estimates that here at this one place there is information immediately available that would take us at least two years of research in the U.S. to obtain. Also enough here to expedite our jet engine development program by six to nine months.

Recommendations to the Commanding General, U. S. Strategic Air Forces in Europe (Lt. Gen. Carl Spaatz), from his Deputy (Maj. Gen. H. J. Knerr) included the comment, "Occupation of German scientific and industrial establishments has revealed the fact that we have been alarmingly backward in many fields of research. If we do not take this opportunity to seize the apparatus and the brains that developed it and put the combination back to work promptly, we will remain several years behind while we attempt to cover a field already exploited." In addition, it was suggested that immediate dependent families be allowed to accompany the scientists, a move considered essential in view of the political and economic factors involved in their general uprooting. As these and other communications indicate, it was believed urgent that immediate action be taken to transport scientists to the United States without delay. The motivating reason was to insure the employment of those top-ranking scientists who were without question the

A document from the archives of the US National Air Intelligence Center at Wright Patterson Air Force Base.

This topic also provides us with a number of valuable ones for the future

Conclusions, if we look at it from the point of view of development theory: why did this process take place so quickly - or to put it another way: why was it relatively slow after the war?

The simple answer is: it leads nowhere, everything with that

justify the existence of total war. After all, there were dozens of other countries involved in the war that did not make such a development, and besides, there have been many wars in history.
Let's recall that in a period of about five years, several generations of technical progress have been made in devices.
Today, the development time of a new tank or aircraft is on average 15 years.

I must admit that I have never come across a comprehensive analysis of this phenomenon. Therefore, I will present my own opinion on the reasons for the rapid progress here.

There were, of course, various reasons for this, and the strong pressure from state institutions was undoubtedly one of the most important. In the Third Reich, however, an additional factor was in the foreground. Research and development work turned out to be quite profitable for both small businesses and large companies.

A German electron microscope from the 1930s which, among other things, enabled genetic research by observing changes in chromosomes. Thanks to this research, a cancer screening program was started that was about 30 years ahead of other countries. For example, even before the war there were strict norms for the maximum allowable concentration of carcinogenic substances in the workplace. (Photo: AEG)

Karl Otto Saur, who was in Speer's ministry for the organization of the

was responsible for industrial production, explained during an interrogation on August 9, 1945 that the system of fixed prices imposed by those in power significantly reduced the cost advantages of mass production. In his opinion, "the

> consortia did not make money from the volume [of goods produced], but from the constant development of new and complex types [of weapons]."

In this case, profits were not so tightly constrained as there was no way to determine the exact cost of labor.

A crucial but seldom mentioned driver of technological progress in the Third Reich was also the need to rationalize technical processes caused by the shortage of labor and raw materials. Therefore, to a greater extent than anywhere else, for example, mechanical cutting operations have been replaced by plastics processing (moulding, pressing, pressure welding, and the like) that required considerably less material and energy. This led to breakthroughs such as the introduction of the MP-43 automatic carbine, which was made almost entirely using plastic engineering, or the downsizing of vacuum tubes to thimble size.

In addition, the production of plastics was advanced in this way. But even these are not the most important reasons. Two other seldom mentioned factors played important roles: 1. It is worth thinking about how progress itself comes about.

> I'm certainly not the only one who thinks that it can be defined as a projection of a culture - I don't mean the way cutlery is placed on the table, of course, but rather a construct of thought created by a civilization. In this case comes into play the most valuable achievement of Europe during the last centuries, namely the tradition of intellectual criticism and its main manifestation: the relativism of ideas. In moral terms, this is often judged negatively (and ultimately the technological achievements of the Third Reich have at least a questionable moral dimension, although one has to wonder whether pure scientific and technological progress can be evaluated from a moral point of view at all). Of the

However, relativism of ideas is a necessary condition for progress. Without it, a culture tends to stagnate. However, this alone was not enough, but only represented the starting point for a certain process, which requires another factor:

2. In analyzing Germany's wartime performance, the rather unusual way in which science was managed and harnessed for the defense industry is surprising. Research was carried out in many different directions at the same time, and this meant that the 'preselection' by academic science was much less rigorous compared to today. Research and science were not controlled by professors, at least not to the extent that they had complete control of science. The academic exclusion of new ideas has been abolished or at least severely restricted. Otherwise probably not even the V2 rocket would have been built.

   Initially, the British Intelligence Service, based on the opinion of various professors, thought it impossible to build such a large liquid-fuel rocket. The first fragments of the rocket fell into the hands of the Polish Home Army (the AK, the largest military resistance organization in occupied Poland), where they caused a great deal of excitement. Nowadays, these achievements do not seem particularly exceptional to us; at that time, however, the invention of the delta wing already represented an important psychological breakthrough. Let's consider how long in most armies, up to the turn of the 1930s and 1940s, the decisive advantage of armored forces was overlooked. Tanks squandered their potential by only using them to support infantry (France had more tanks than attacking Germany).

   The same is true of the dive bomber concept, and countless other examples could be found.

The more unusual an idea, the greater and more irrational the resistance to putting it into practice. Einstein would probably never have been able to convince Roosevelt to build the atomic bomb if there had been no information about corresponding efforts in Germany. As late as 1923, Robert Millikan, general, closed

recognized authority and Nobel laureate, categorically ruled out any possibility that an atomic nucleus could ever be split. Using the same principle, the eminent American astronomer FR Mouton in 1932 denied the possibility of manned spaceflight.

Anyone who has ever spoken to professors knows that there is great resistance to new ideas. The main criterion is whether these ideas can be explained with existing knowledge. Science does not concern itself with what it does not know, and above all with what it does not understand. This is the greatest obstacle to development today. As a result, research into phenomena such as the "separation of magnetic fields" described in Part 2 is currently almost impossible. It's just something completely new.

The prevailing rule in these things is that we only ever see those things in the world that are already laid out in our heads. In other words, if the idea doesn't already exist in our heads, then our eyes overlook the facts. According to popular belief, breakthroughs happen suddenly, almost as an immediate realization. In reality, however, this is never the case. Information about a certain aspect of reality is always there, just not always perceived. From here it is only a small step to adapt reality to the existing theories.

The reorientation of science, which the Third Reich was forced to adopt, not only brought with it an optimization of the existing structures, but also developments that simply had to be described as revolutionary. Without such a realignment, we will continue to spin in a magic circle today, no matter how much money we have at our disposal. Apparently, such developments can only take place under certain conditions, at a certain level of social consciousness. We need something opposed to today's mass culture (which tends to suppress real information) - we need that tradition of intellectual criticism, the "positive relativism of ideas". And although it may seem so, such a state of mind does not require war, and certainly not National Socialism!

The concept of revenge weapons

Contrary to expectations, the weapons hidden behind the title of this chapter are not only the V1, V2 and V3. The concept of a retaliatory weapon evolved over time and also encompasses a number of projects that can be termed the "second generation of retaliatory weapons". What made them stand out?

Of course, this question can easily be answered by referring to the German classification - and only looking at the projects of the "V" series. However, the question is not so easy to answer, as there were already a number of further developments that were not listed under this classification, even if they have many things in common with the V1 and V2. So we need to agree on a rule that separates "retaliatory" from "conventional" weapons. It appears that the retaliatory weapons were designed primarily as long-range weapons, designed not to attack military targets but to attack enemy civilians. Of course, such a distinction can never be entirely clear-cut, and this is more or less true for many of the weapons described in the following chapters, but especially for strategic post-war missiles.

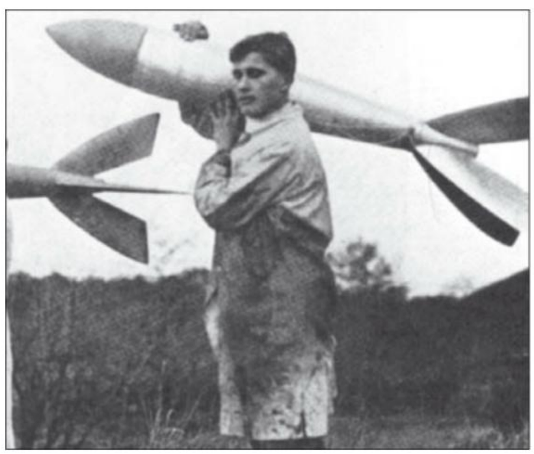
For this reason, this program should rather be seen as a historical achievement. To begin with, let's look at where the concepts of 'retaliation' and 'deterrence', so important in the post-war period, originated. This may surprise some readers, but the originator of these concepts was Hitler, although the meaning, the possible goals and the principles for the use of retaliatory weapons were not initially clearly defined. The main reason for the Fuhrer's interest in them was simply their modernity. The army needed an impetus with the latest technology, which would make up for its numerical inferiority with its qualitative superiority and with its radically new capabilities would have the direction of the shifting borders on the map of Europe

can reverse. In short, they were purely military reasons, motivated by new uses.

Over time, as the development of retaliatory weapons got down to the hard technical facts, a second dominant aspect emerged: the terror factor. This aspect can largely be traced back to the special perspectives and traits of Hitler's character, who often favored offensive action over simple military strategies and tended to favor the psychological effects of a weapon rather than considering purely military and rational effects. This can be seen from the course of numerous operations. The man who perhaps knew Hitler best was Albert Speer. After the war he wrote: "... even as a leader, he considered the psychological effects, rather than the military effects, of[1]

a weapon chiefly.

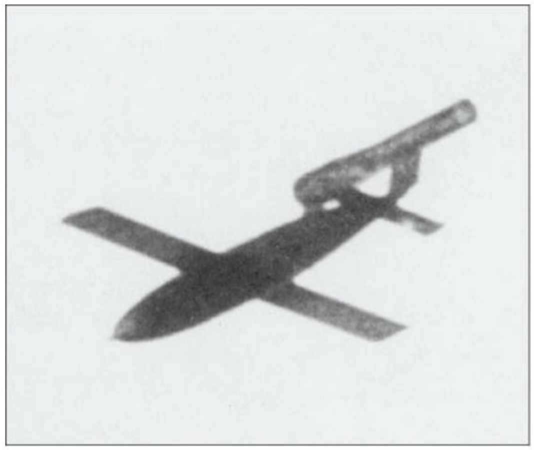
An example of this was his idea of attaching sirens to the bombs dropped by the Stukas, whose demoralizing effect was more important to him than the explosive power of the bombs themselves[1]."



Wernher von Braun in the early 1930s. Who would have guessed back then that his rockets would one day take humans to the moon? (unknown photographer)

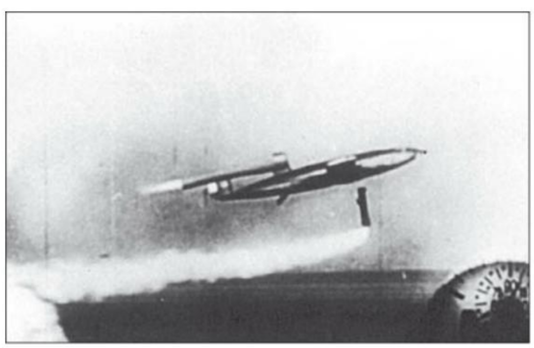
The issue of retaliatory weapons took on a more realistic stance as the Germans threatened to lose the battle for Britain. Regardless of the psychological factors already in place, a weapon was needed that could take over the Luftwaffe bombers' task of conducting long-range air strikes. All of this should also be without air superiority and completely without the cover of their own fighter planes

to be possible. Hitler persisted in sustained and grueling assaults that would become a psychosis of permanent, inescapable, and unpredictable danger for the enemy.



The V1 in flight. (Photo: Federal Archives)

Originally he wanted to realize this concept with the help of a new bomber. That would have been at least a very peculiar form of air warfare: the flight engineer Ernst Heinkel considered only 40 to 50 machines necessary for the success of this strategy, which at a flight speed of 750 - 800 km/h at an altitude of 14,000 meters were out of range of the Allies would have been fighter pilots.
In any case, this became possible relatively quickly – with the introduction of the jet bomber towards the end of the war.



V1 launch from a catapult. (Photo: Federal Archives)

To achieve maximum "intimidation" they would have had to fly day and night (Hitler was enthusiastic about the

imagining that millions of people would jump out of their beds for just a few bombers); however, each bomber should only drop a single large bomb. Incredible as this may sound, Hitler genuinely believed that his troops could use this minimal but modern "terror effect" to turn the tide of the war. It is strange that this conviction lasted so long, even though the Allied air raids, which fell on German cities on an incomparably greater scale, could not break the German will to fight.

The first weapon in the Vengeance Weapons repertoire is of course the V1, although work on the V2 spanned a considerably longer development period.

The V1

The inventor of the concept of the "long-range winged bomb" - or as we would say today, the first cruise missile - was Dr. Fritz Gosslau, test engineer at Fieseler-Werke. The idea itself came up just before the outbreak of war. The Luftwaffe rejected it from the start, but Gosslau decided to continue research with the aim of constructing a prototype towards the end of 1941.

He wanted to use a simple and inexpensive engine to power the bomb, such as the deflagration jet engine that his company had developed in 1939 on behalf of the Air Ministry. Despite the high fuel consumption of this engine, its simple design and the fact that it did not use scarce materials under wartime conditions were decisive advantages. The drive was built without a rotor, i.e. without a compressor and turbine. It was based on the principle of the piston engine with a compression, combustion and exhaust cycle, only it worked in a completely different way. The combustion chamber consisted of a steel tube with a diameter of about 0.5 meters, had an opening on one side and an air intake with a valve system on the other side.
A certain initial speed was needed for the engine to work, and it worked in the following way: Air pressure at the front opened the spring-mounted ones

valve intake seals, and the combustion chamber filled with the fuel. This was followed by ignition, which caused a sudden increase in pressure in the tube, which closed the valve intake seals again. The exhaust gases escaped under the force of their own pressure, giving a recoil. Due to the great length of the pipe and the inertia of the petrol, a negative pressure was created in the combustion chamber; the intake valves opened and the whole cycle started over. The spark plug was only used to start the engine. After that, the cycle repeated itself automatically until either the fuel ran out or the supply was interrupted. In the Argus As-109 engine, this cycle repeated 40 to 45 times per second, producing a noise similar to that of a running piston engine. On the other hand, due to the strong vibrations, this put a considerable strain on the structure. On the basis of this engine, Gosslau developed his "flying bomb" with a warhead of one ton. The fuselage and wings were made of steel with wooden elements (mainly the wings).

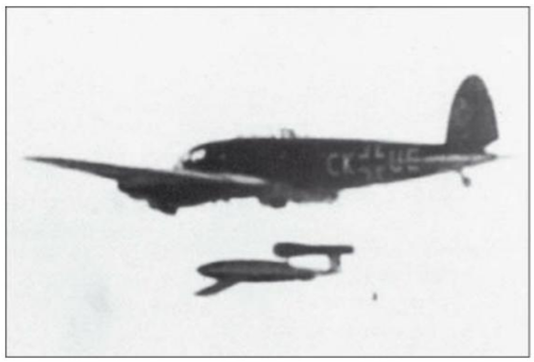
The metal cladding consisted of a thin layer of steel less than three millimeters thick. In contrast to the V2, the construction of the V1 and in particular its drive was extremely inexpensive and simple. The first draft was submitted to the technical department of the Air Ministry for evaluation under the working title "Fieseler Fi-103" on June 5, 1942.
The constantly deteriorating military situation and, above all, the defeat in the battle for Great Britain changed the previous attitude of the military towards this type of weapon. Hitler demanded retaliatory weapons that could be produced and used in large quantities. In the same month, the Fi-103 project was given top priority.
At the same time, the rocket received the military "code name" *Flakzielgerät 76* (FZG 76). Marshal Milch placed great hopes in the project for which he was responsible on behalf of the Luftwaffe. The hitherto serious disadvantage of limited accuracy, which was decidedly too low with regard to "normal" targets, became less important as the military situation changed. The technical demands and the specific nature of the anticipated military deployment fitted Hitler's characteristic view: limited resources - and great psychological impact.

With the further development of the Fi-103, the testing site of the

Luftwaffe at Karlshagen near Peenemünde, where Major Otto Stams was appointed commanding officer in August 1942. A launch facility for the missiles was set up at a local airport.
In order to meet military requirements, many components had to be overhauled or developed from scratch. This work was integrated into a larger program called *Vulkan* , which was developing guided missiles for the Luftwaffe. In addition to engine and airframe improvements, the gyro autopilot and launcher have been completely redesigned. For this purpose, specialists from the company Askania (autopilot) and Rheinmetall-Borsig AG were hired. The Germans very quickly managed to get the first prototype ready for in-flight testing by September 1, 1942, although the engine had not yet been fully tested and was causing numerous problems, particularly at high speeds.

On May 26, 1943, a conference of the "Research Council for Long-Range Missiles" was organized in Peenemünde, attended by generals in the air and ground forces, including Milch, Keitel, Olbricht and Fromm, as well as Admiral Karl Dönitz, representing the Navy, and Albert Speer, the Reich Minister for armament and ammunition. The aim of the conference was to evaluate the two hitherto "rival" retaliatory weapons, the Fi-103 and the A4. After a long discussion, it was agreed with Dornberger, head of the German missile weapons program, that both types of weapon had their advantages and disadvantages, which were not mutually exclusive, but rather should be viewed as complementary. In this context, both projects were given top priority. This was a great success for the Luftwaffe, since the two attempts with the Fi-103, in contrast to the A4, failed embarrassingly before the eyes of the council members: one rocket crashed shortly after take-off, the other did not even manage to take off. It was obvious that the "flying bomb" needed further improvements and many months of research. In the meantime, the means and possibilities for building war-capable launch pads were studied. It was not yet clear whether solid concrete structures, which would be well protected against air raids, should be used, or whether simple but more numerous field ramps that would be easy to erect should be preferred. In June 1943 it was finally decided as a compromise, four fortified concrete launch pads

and to build 96 field ramps off the coast of the English Channel. The deployment of the first combat units was initiated. Meanwhile, there was nothing to indicate that the missile's technical problems could be resolved quickly. Of the 68 rockets fired during the first two months after the Peenemünde conference, only 28 made a flight that was classified as successful (41%). Many of the rockets crashed shortly after launch for unknown reasons. The Germans had still not been able to check some of the targeting systems, including the important navigation system.



Test launch of the V1 from a He-111 bomber. (Photo: Military Archives)

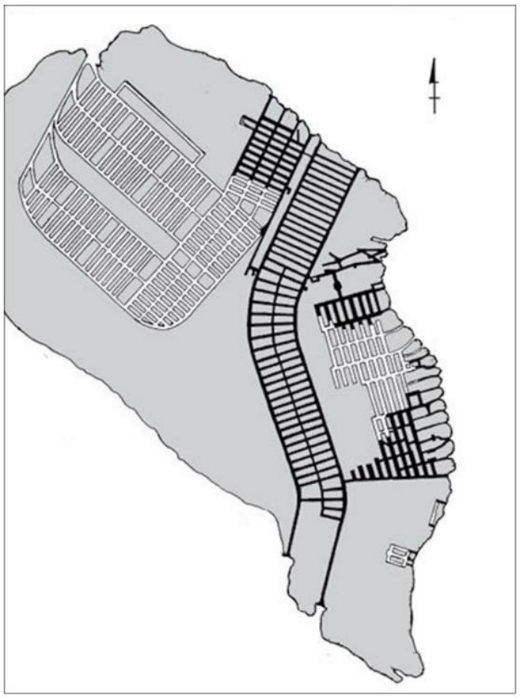
The desired timetable for the attack on London on December 15, 1943 therefore seemed completely untenable. Production schedules looked similarly unrealistic: 100 missiles were planned to be delivered to the Luftwaffe in August 1943, 500 in September, 1,000 in October, 1,500 in November, and then gradually from 2,000 to 5,000 per month.
At the same time, the impacts of the tested missiles were so far apart that no reasonable guarantee could be given for a direct hit on London. On September 10, Marshal Milch said:

"I'll be satisfied if the Fi-103 works at all so that we can use it in combat." This contradicted his extremely optimistic expectations of

its military effectiveness. He surmised that London could not withstand a mass attack for more than two to three days - a completely illogical assumption, since German cities had often survived heavy attacks that had been at least as strong.

The Volkswagen factory in Fallersleben was the first plant to produce the Fi-103. However, it soon became necessary to re-examine the research, testing and production plans for the V1, as well as the problem of countering enemy espionage. In order to eliminate enemy espionage, foreign workers were not used.

As a result of the construction defects on the Fi-103, production in Fallersleben was stopped in November.

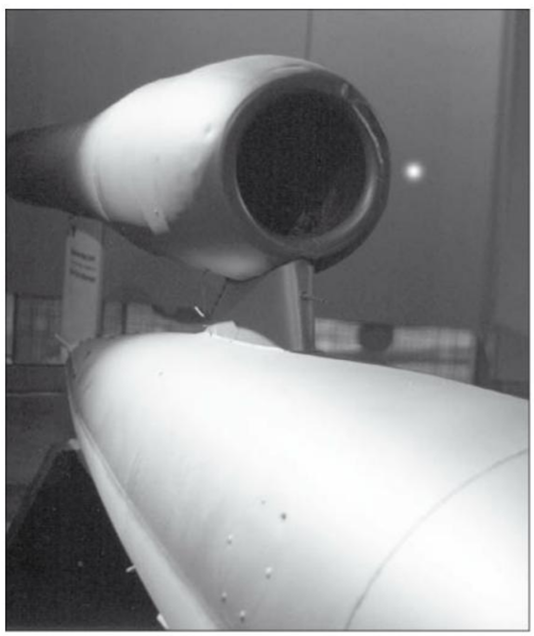


Map showing the underground factory system under the Kohnstein. The tunnels that were actually built are highlighted in black, the planned ones in white. (I. Witkowski)

Later, the underground facility "Mittelwerk" near Nordhausen in the Harz Mountains was chosen for the production of the V1 and V2. In this context, the newly created company Mittelwerk GmbH took over the factory. Two parallel tunnels were drilled through the Kohnstein, the main supply sections of which were 10 m wide and 7.5 m high. Between the main tunnels were 50 transverse production halls for the individual construction phases, each with a length of 140 m. When the factory was taken over by Mittelwerk, its volume was 875,000 m³ and the area of the tunnels and galleries was 125,000 m². The workers were prisoners of the concentration camp

Nordhausen, mostly Poles, French and Russians. The assembly of the "V rockets" and the production of various components also took place in other underground facilities, including the production facilities of Askania Werke AG near Helmstedt (responsible for the control system) or the underground factories of the AEG consortium near Hadmersleben and Hersbruck, in which electronic components were produced.

The beginning of 1944 brought another "turnaround" in Hitler's plans - in favor of the V1. The technical design flaws could only be remedied through intensive research. From now on, the rockets were tested in large numbers and no longer exclusively on the Baltic Sea, e.g. B. at the Udetfeld airfield in Upper Silesia and in mid-March then also in the area around Blizne in occupied Poland, from where only the V2 had been launched so far. “Flying bombs” were also launched in the region between Lublin and Chelm in Poland. One of the German reports reads:



The V1, close-up of the air intake opening. (Photo: I. Witkowski)

“In one incident, people and animals were killed immediately by the blast. Houses and other buildings also burned down. As a result of the 12th launch, the village became

Adampol partially reduced to rubble."

The V1 at the National Air and Space Museum in Washington. (Photo: I. Witkowski)

Finally, the Germans managed to reduce the dispersion of the impacts to an acceptable level. Between August 18th and August 26th On November 1, 1944, almost 260 rockets were launched, but only 17% of them hit the target area 225 km away (diameter: 30 km) or the target area 100 km away (diameter: 15 km). In October, however, the rate had already reached 32%, increasing to 46% by November. Production in the Mittelwerk factories in Nordhausen was now fully under way.

A crashed V1 rocket found by American soldiers in France. (Photo: US Army)

In connection with the invasion of Normandy was the command

decreed that the attacks would begin "as soon as possible" on June 12, a deadline that could not be met. The combat units were still not adequately prepared and there were supply problems due to the opening of a new front and the bombardment of many railway junctions. The Germans never managed to deliver concentrated perhydrol in time to power the launchers. As a result, only ten rockets were fired towards London that day, of which only four reached England; five crashed right after takeoff.

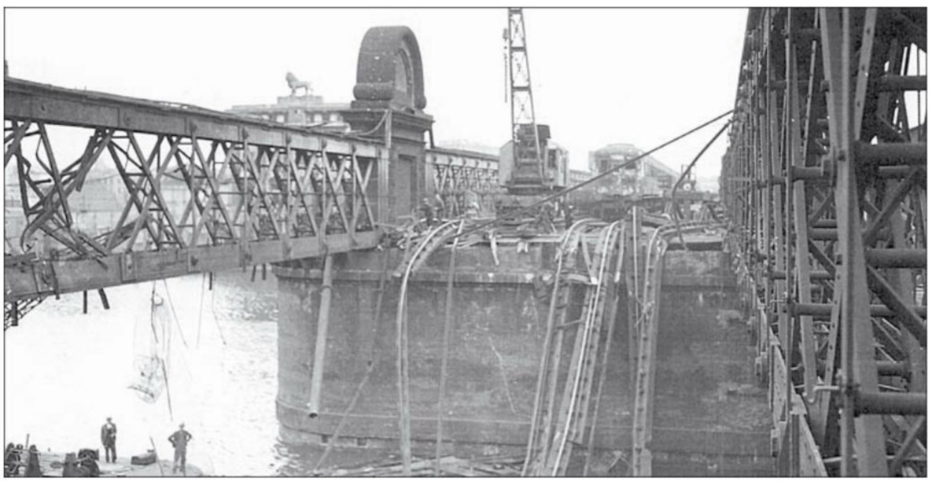
Remains of the V1 in one of the halls of the Mittelwerk. (Photo: I. Witkowski)

Finally, it was decided to repeat the start of the operation three days later, just before midnight. 55 launch pads opened fire, which continued until the afternoon of the following day (June 16, 1944).
During those 24 hours, nearly 100 V1 rockets were launched, up from 500 by June 18. Depending on the launch pad location and other factors, the flight time to London was around 25 minutes.

After ten days of attack, the English already registered 370 direct hits on London. On June 28, a V1 struck the Air Force Ministry building, killing 198 people. A short time later, the number of casualties and destroyed and damaged buildings was in the thousands. Output from London's war factories fell by about a sixth. 3,4,5

All in all, the Germans managed to launch 6,046 rockets by the end of the year, but 1,681 (27.8%) of them crashed, 795 of them in the immediate vicinity of the launch pad. The greatest intensity of operations

was recorded in the early stages: 1,000 V1 rockets rolled off the launch pads during the first few days of the operation through June 21. In the following and final year of the war, 1,279 rockets were launched, of which 986 reached Britain. The significant number of failed flights revealed the frantic nature of the production, preparation and deployment of this innovative weapon. It is a testament to the technical shortcomings and deficits that could have been eliminated if time had not been so pressing. A relatively large percentage of "losses" were due to poor maintenance of the catapults, despite their simple design. By August 6, in the first two months of the operation, 34 rockets had exploded on launch.



Hungerford Bridge in London after being hit by a V1 missile. (Photo: US Army)

After a short time it was decided to look for the causes of the failure. The 245 rockets that had crashed as of July 24 were categorized based on the cause of their crash. Most crashes, namely 70 (28.6%) were caused by errors in the airframe construction, 62 (25.3%) by incorrect operation of the catapult, 40 (16.3%) by engine problems, 34 (13.9%) from malfunctions in the navigation and control systems (missiles sometimes “circled” in the air around the launch pads), and five (2.0%) were due to errors by maintenance personnel. The cause of 34 incidents could not be determined.

During the final months of the war, the Germans could no longer turn their Vergeltungswaffe 1 against Britain,

instead they now targeted Belgium.

In conclusion, the actual impact of the missile after a year of combat use should now be summarized. In total, all ground ramps fired 20,880 rockets; only 18,435 hit their target according to the available records. The following figures reflect the hits on individual cities: 7,796 hits on London, 44 on Southampton, 7,687 on Antwerp, 2,775 on Liege and 133 on Brussels. In addition, around 1,600 V1 rockets were dropped by KG-3 and KG-53 bomber squadrons towards London, Southampton, Gloucester and Manchester.

Technical details of the V1 (Fi-103 A1)

Launch weight: 2,152 kg	
Warhead mass: 830 kg	
Length: 8.35 m Range:	
	240 km
Engine length: 3.66 m	
Hull diameter: 0.84 m	

The V2

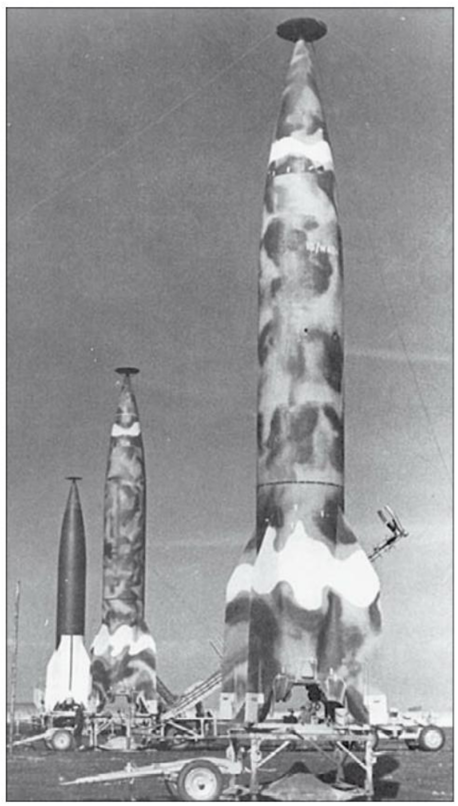
From a purely technical point of view, the V2 rocket was a much more interesting design. Although it represented the pinnacle of the technology of the time, it was basically a very advanced development of amateur rockets of the early 1930s. 3 Rudolph Nebel, Klaus Riedel and a group of rocketry enthusiasts

built the first experimental rocket in 1930, named *Mirak* - an abbreviation of the word "minimum rocket". In this group was the then completely unknown 18-year-old Baron Wernher von Braun. For the test flights, these enthusiasts rented an old Reichswehr shooting range in Reinickendorf on the outskirts of Berlin. It was September 1930.

At the end of 1938, the Wehrmacht staff already specified the first requirements for the A4, which had not yet been designed and which was also known as the V2. It should be operational by the end of 1942. For this purpose, the expansion of a research base was planned, the location of which had already been finally selected in April 1936: Peenemünde. General Becker (representing the Army Weapons Office) and General Kesselring (of the Luftwaffe) signed an agreement

about the joint construction and use of a large research center on the island of Usedom. 20 million marks were earmarked for this goal, and just one year later the rocket experts moved to Peenemünde. Her possibilities were now incomparably greater. First and foremost, the Germans concentrated their forces on building a supersonic wind tunnel, which had not been done before. Only relatively small models could be examined with the previous one: It had a cross-section of 10 x 10 cm. However, a second one was soon built with a cross-section of 40 x 40 cm, in which flow velocities of up to Mach 5 could be achieved.

The number of employees in this complex rose continuously from 50 at the beginning to 15,000 people in 1943.



V2 rockets with military camouflage paint, set up on mobile launch pads. (Photo: National Air and Space Museum, Washington)

The advances made in the rocket tests carried out in Peenemünde slowly convinced the military of the military importance of rockets and the enormous development potential of this new weapon of war.

In the foreseeable future they could outperform not only the Paris gun from World War I, but also any other modern means of transport (including airplanes). The arms race, which was set in motion by the Germans' intensive preparations for war, enabled the scientists in Peenemünde to realize their boldest projects.

In November 1938, General von Brauchitsch ordered preparations to begin mass production of the A4 rockets so that this phase could be reached as soon as the trials were completed. A special group from the research and development department of the Army Weapons Office was tasked with supervising this work, and Colonel Dornberger took over the management.

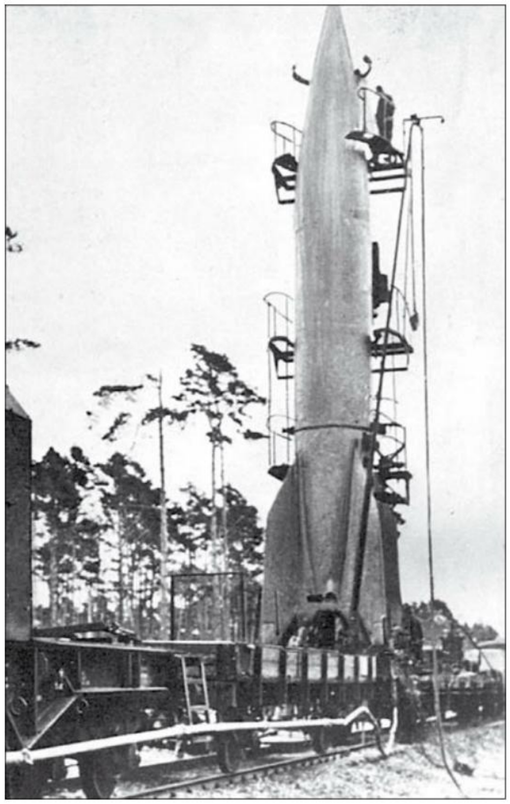
At that time, the development of a final, super-modern engine for the A4 rocket was in the final phase. It was the merit of Dr. Walter Thiel, engineer Pöhlmann and many of their employees. As a result, an engine with a thrust of 25 tons, but very small dimensions (the length of the combustion chamber was only 30 cm) and very high efficiency (about 95%) was developed. This engine completed the first tests on the test bench in the spring of 1939. A key stage had now been reached on the way to the construction of prototypes of the later V2.

As it turns out, Wernher von Braun, known as the "Father of the V2", had almost nothing to do with the development of the engines for the "A" rockets. The true originator of the "heart" of the rocket was the forgotten genius of German rocketry, Dr. Walter Thiel, also famous for developing a powerful 200-tonne engine for the A9/A10 assembly.

Thiel himself died during an RAF air raid on Peenemünde on the night of August 17/18, 1943. It was probably the Germans' greatest loss of the night; the research and production buildings were not particularly damaged (however, many forced laborers lost their lives, including Poles).

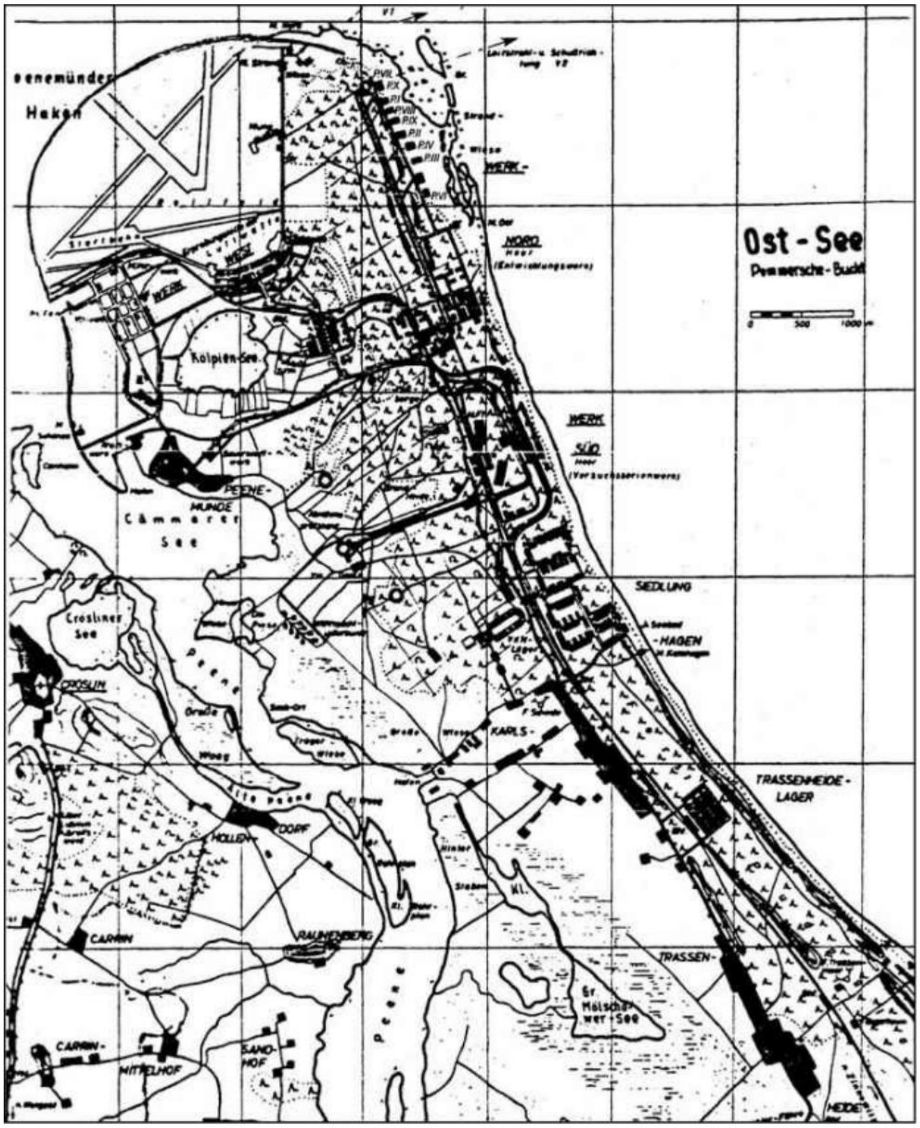
Research into liquid fuel engines, using oxygen as the oxidizer, was initiated before the war. The first success was the development of an engine with a single injector and a ton of thrust. The injector was here at the same time the

Pre-combustion chamber for the fuel and the oxidizer.



Preparations for the launch of a V2 rocket from an orbit launch pad (photo: military archive)

This system became the basis of the V2 engine. During the entire development history, the key element, the injector, was hardly changed, only their number and the size of the combustion chamber and nozzle were increased. First an engine with three injectors and a thrust of four tons was built, and finally the final version of the engine for the V2 with 18 such injectors.



An original German map of the facility near Peenemünde.

The increases in the size of the rocket also raised the problem of sufficient cooling, because the larger the engine, the more heat it produces. In practice, a few kilograms per second of fuel and oxidizer flowed into the rocket's engine during the first five to seven seconds; initially only by its own weight. This was the "warm-up phase" of the engine. After the pump started, 60 kg of fuel (alcohol) and 75 kg of oxygen reacted within one second. Paradoxically, solving the heat problem also required a lot of fuel, since it was best used as a coolant for the nozzle. This also proved to be the case for future ones

Space rockets as a reliable method. 6,7 The rocket's nozzle consisted of two layers between which the alcohol fuel flowed.
In this way, the demands on the inner wall of the nozzle in terms of mechanics, durability and heat resistance were significantly reduced, because it only had to withstand the pressure difference between the pressure of the fuel and the pressure in the combustion chamber. Thus, a number of serious problems were avoided, and the rocket could be made “only” from mild steel.

At almost the same time, missiles were also being worked on in the United States. However, scientist Robert Goddard did not find a suitable solution there, so the rockets were usually completely burned out after five seconds! However, the soft metal of the V2 engine performed exceptionally well, apart from temperatures of up to 3,000°C in the combustion chamber, which dropped to around 1,650°C in the nozzle orifice. However, tests showed that thanks to the efficient cooling, the temperatures on the inner wall of the nozzle did not exceed 950 °C.

Another factor that made the aforementioned engine highly valued after the war was its light weight, which was only 8 percent of the take-off weight. In comparison, the weight of the seemingly simple V1 engine was 24%. Thanks to this fact, the fuel occupied up to 69% of the weight of the V2, which remained an unbeatable value for a long time.

When discussing the engine properties, it should also be mentioned that research in this area in Germany took a two-pronged approach. Regardless of the work on the V2, Dr. Walter conducted his own research. His famous engine for the Messerschmitt Me-163 shared many similarities with the V2 engine, but used a different fuel.

The next Pioneering was a "Thrust to the Vectoring" control system developed for the V2, which allowed deflection of the nozzle's exhaust plume. This made it possible to achieve stability even at very low flight speeds, for example shortly after take-off. Thus, the rocket could be launched vertically from a small and simple launch pad. The omission of a large, stationary launch pad was one of the key advantages of the V2 over the V1. Such a ramp would have had to be so big anyway that the production

such a rocket would no longer have been worthwhile. The four hydraulic thrusters were made of heat-resistant graphite and were mounted just behind the nozzle opening. With the help of a simple chain transmission, they were connected to the aerodynamic air rudders at the stern.

[7]

Along with the development of the first large rockets, most notably the V2, a whole series of groundbreaking research programs were launched. They laid the foundation for the future development of missile technology, on the basis of which the nuclear missile race continued several decades after the war. The V2 was one of the first missiles to be equipped with an inertial navigation system and controlled by an electromechanical flight management system. This principle was later used in all ballistic missiles with nuclear warheads. Among other things, the flight sequence programmer did not allow the warhead to detonate directly on or near the ramp, i.e. after a possible engine failure, which was quite common in the beginning. The warhead was primed in flight only after the program was completed. If a rocket fell onto the launch platform and was loaded with explosives, the warhead would still detonate due to the burning fuel and the very high temperatures. The personnel then had about 20 minutes to be evacuated and escape with their lives.

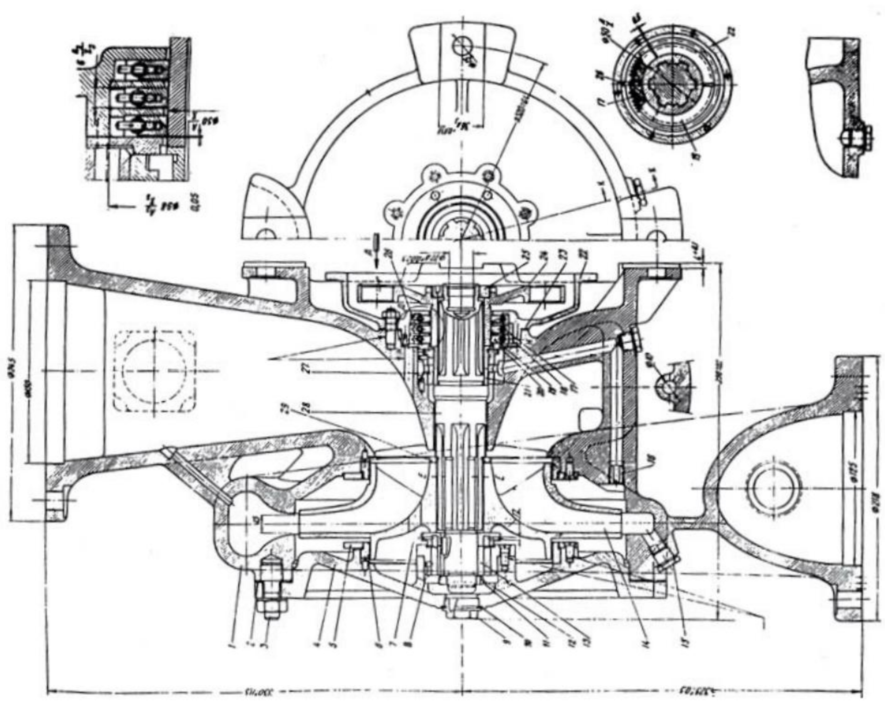
At least "theoretically" there was also the possibility of extinguishing the fire - but if the rocket exploded together with the warhead, it could destroy the entire infrastructure of the corresponding facility. The warhead had such a high explosive power that it usually destroyed entire residential areas. This was the first problem that had to be solved during the research and development work.

The next, and similarly important, problem was to study the conditions encountered by the rocket during re-entry into the Earth's atmosphere (at a near-vertical flight orientation, a maximum altitude of 172 km was reached, with an altitude of 100 km being considered the limit of the Earth's atmosphere ; the maximum speed exceeded 5,000 km/h). From the outset, it was clear that these conditions were unlike anything previously known.

Above all, there was the danger that the outer skin would melt and the hot

steel it was made of could soften or even oxidize from the friction of the hot air. Efforts were therefore made to determine the temperature distribution on the nose of the "falling" rocket in particular.
First, based on the test results in the supersonic wind tunnel, the maximum temperature should be calculated, or rather estimated. A special model was made for this purpose, with bimetallic sensors embedded in the outer skin directly below the surface. Based on the tests, it was estimated that the outer skin of a real rocket should heat up to a maximum temperature of around 600 °C.

Special sensors were then constructed and installed in a measuring version of the V2 warhead. There were a great many of these sensors —miniature discs attached to the hull, each with a slightly different melting temperature. They were connected by cables to an electrical sensor that emitted an electrical impulse when the disk melted. The sensors, in turn, were connected to a telemetry device on board the rocket, which immediately transmitted the relevant parameters via radio directly to the ground station. The insights gained along the way showed that the temperature actually rose to 650°C (- suggesting that the rocket would have been visible at night: entering the dense layers of the atmosphere at top speed it would have entered glowed a bright orange). After these tests, it was decided that no major design modifications were necessary. However, later confirmed cracks in the fuel tank and leaks in the internals caused by the "pressure" of the shock wave made it clear that the extent of these problems had been underestimated. As a result, development of the missile was halted for several critical months, just as the pressure to get it into production was at its peak.



A cross-section of the V2's fuel pump. (original drawing)

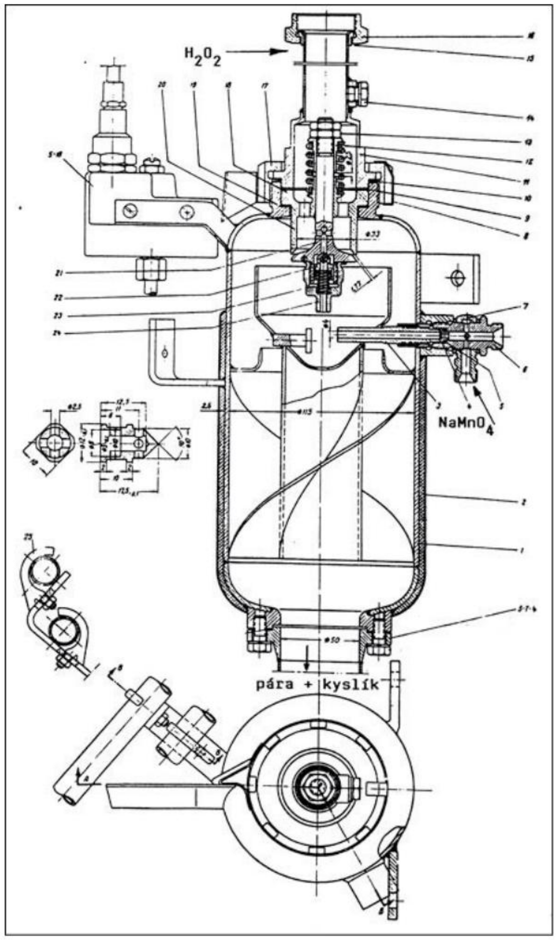
Almost a "cosmic" challenge was the problem of designing a suitable propellant system with a working pump that could withstand such extreme demands - a problem that British and American experts had previously declared insoluble. They only changed their minds when the intelligence of the Polish People's Army handed them parts of the V2. It was a device that would be small, light and reliable, capable of pumping 150 kilograms of fuel per second (!) into the combustion chamber (which was already under tremendous pressure) within about two seconds of activation.

Despite these hurdles, a pump was finally built that met these requirements and was small enough and light, compared to the five-story rocket, that it could be lifted by a single human. It was a relatively flat turbine with a diameter of 47 cm and a power of 500 - 600 HP (the Walter drive, developed by the company HWW from Kiel). Their extremely efficient energy source consisted of 80 percent hydrogen peroxide, which was catalytically decomposed using an aqueous solution of potassium permanganate.

The reaction proceeded at a temperature of 460 °C and produced a

Mixture of water vapor and oxygen under a pressure of 24 atmospheres.

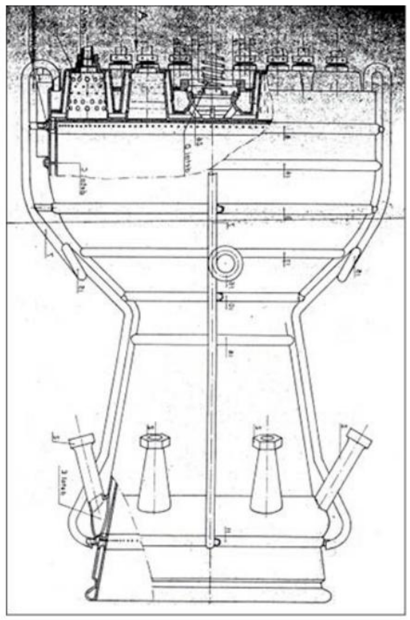
6.7



The reactor in which the catalytic decomposition of hydrogen peroxide took place.
Its diameter was only 12 cm. (original drawing)

The outbreak of war in September 1939 coincided with significant advances in research and the project was given top priority. This guaranteed adequate funding and the regular supply of strategic raw materials, even if the allotted time to complete the research was reduced twice. From now on, the scientists had until September 1941, when the A4 rocket was to go into mass production. A large number of researchers and civilian designers were supported for this purpose by around 4,000 technically trained soldiers who, once the work was completed, would form the core of the missile combat units of the

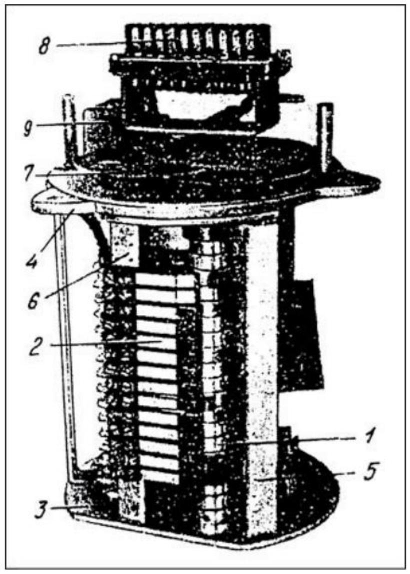
Wehrmacht should form. A further acceleration of the work was soon expressly demanded and additional workers were sent to Peenemünde. The research and development program was given the highest priority, even as preparations for mass production were interrupted by Hitler's intervention. 6



The propulsion of the V2 rocket.

The early months of 1940 were a tenuous period in the development history of the German missile program. Deliveries of raw materials were severely curtailed, due to Hitler's dislike of any long-term research program for new weapons. He relied too much on the experience of the first blitzkrieg and counted on relatively quick results in the development of the military situation in Europe.

As a result, he viewed such programs as something of a "resource eater" - an attitude that would have a crucial impact on the course of future campaigns. Many programs fell victim to this short-sighted policy, including the program to develop an atomic weapon, which the Germans were several years ahead of the Americans in realizing by 1941.



The flight sequence programmer of the V2.

The second unfavorable influence came in the form of the Reich Minister for Armament and Munitions, Fritz Todt, who was hostile to long-range missile projects. Like Hitler, but with different arguments, he was of the opinion that the V2 project was a gigantic waste of material and scientific and technical potential that, from a military point of view, did not promise any usable results. It should be borne in mind that at peak times in Germany around 200,000 people were working on the realization of the guided missile program. As early as the spring of 1940, ongoing work was concentrated on overcoming two fundamental problems: ensuring the rocket had sufficient accuracy and improving the technology for engine production, since engine failures were increasing at maximum thrust.

Regarding the problem of the missile's accuracy, investigations in Peenemünde revealed that the errors in the inertial navigation system occurred mainly during the initial phase of flight - during acceleration to flight speed and alignment to the intended trajectory.

This could be prevented by an additional radio beacon *(Viktoria beacon)* with which the navigation commands of the ballistic missile's flight computer were corrected during this flight phase

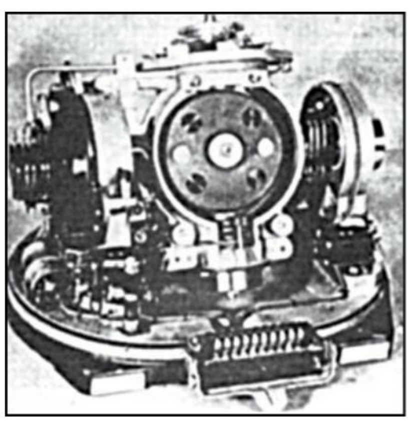
could become.

However, the first opportunities for military use of this version (1944) revealed the considerable susceptibility of the *Viktoria* system to failure, even though the actual concept of flight correction was rated as functional during the first and relatively unstable flight phase.

The Germans wanted to improve the system by significantly increasing the frequency of the beam to around 600 MHz. This work was carried out by a military test facility in Peenemünde under the "care" of a specially appointed "High Frequency Research Commissioner" (BHF).

Under the orders of the BHF, the development of two new radio beacon systems, codenamed *Libelle* and *Gloria ,* began, probably in the fall of 1944. The work was carried out by a small team led by Dr. Run Foul Table and Engineer Battac. To a certain extent, the code names mentioned above referred to a coherent unit: *Gloria* referred to the modified equipment of the rocket, *Libelle* the associated ground transmitter. While the second component was entirely new, the "on board" components were only revised. The antenna system and receiver remained completely unchanged, only a high-frequency converter was added (the original amplifier now served as a pre-amplifier). This was due to the tight schedule and limited space in the densely packed rocket body, which was ultimately not designed for this equipment

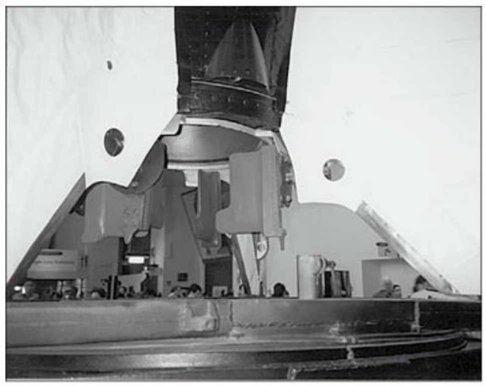
was.



A component of the inertial navigation system of the V2.

The ground system, on the other hand, was fixed practically from the start. At the time of the evacuation of the plant in Peenemünde almost all plans were completed; however, the Germans never managed to build a prototype. 8 (The plans and possibly some equipment were confiscated by the Russians and used in connection with the Russian replica of the V2, the R2 rocket, which went into service in 1950.) Let us, however, return to the interrupted account of the initial work

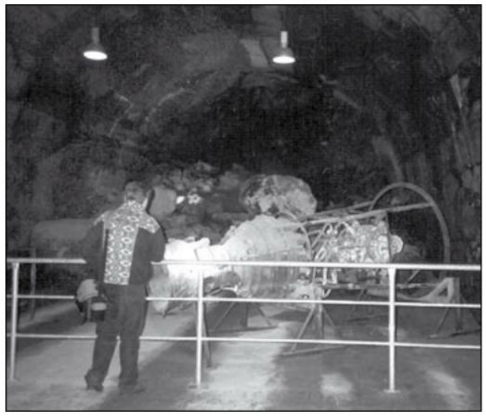
...



The rear of the V2 with recognizable graphite controls. (Photo: I.Witkowski)

In the summer of 1940, the missile program fell further down the priority list. By now Hitler had lost all interest in it. He did not consider the missile to be competitive with the long-range bomber, which could carry far larger "combat loads". 8 Irrespective of this, the increasing number of counter-espionage operations prompted the Peenemünde authorities to sack around 1,000 Polish forced labourers.

Although the development of the A4 rocket was nearing its end, the facilities on Usedom were almost shut down.



Both images show a V2 engine in the underground Mittelwerk complex. (Photo: I.Witkowski)

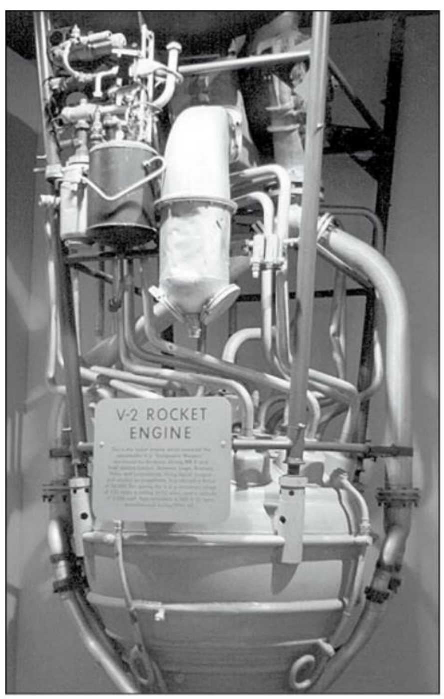
Only the intervention of Field Marshal von Brauchitsch changed the situation. In late July/early August, he gave orders to rank the missile program (under the name *Smoke Trail Device)* as one of the most important programs in the development of new weapons, which brought it back to the top of the list of priorities. Laid-off workers were brought back and the decision was made to expand the research and production base in Peenemünde.

In early March 1942, the Germans managed to assemble the first prototypes of the A4 rocket - the future main retaliatory weapon of the Third Reich. Although the work on the engine was not yet complete and cracks in the combustion chamber were still common, it was decided at the end of March to attempt the first launch. However, the rocket exploded during a first stationary test on the test bench.
The competition with the Luftwaffe and their Fi-103 and the pressure to quickly "prove" that the development of the rocket was complete - because without the final design, series production could not take place either

start -, should indirectly trigger numerous future accidents.

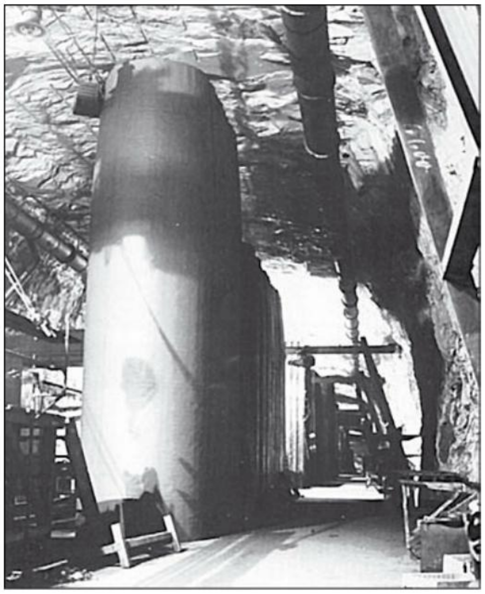
The work was delayed considerably by the bombing in August 1943, but not nearly as much as the Allied commanders would have liked. Despite the deaths of numerous important scientists (including Dr. Thiel), the research infrastructure suffered no major damage from the air raids. Above all, the "small town" of the workers and the barracks of the forced laborers fell victim to them. Work quickly resumed. The launch of the fourth A4 prototype took place on October 3, 1942. It was the first and for a long time the only test flight that was completely successful. The rocket reached a maximum altitude of 60 km and a range of almost 200 km. The engine worked as planned for 61 seconds. In the final phase, the speed was over 1,200 m/s – around Mach 3.75. It seemed as if the technical hurdles had been overcome, but in reality there was still a long way to go.

The successful start proved at least that it was theoretically possible to get the problems under control.



The main part of the V2 engine: injectors with lines that supply them with oxygen and the fuel pump. (Photo: I. Witkowski)

On December 22, 1942, Hitler confidently signed the order to start mass production. Shortly thereafter, a special committee (Range Shooting Development Commission) was formed in Speer's ministry tasked with overseeing the research, production, and use of the Vengeance Weapons. The committee included representatives of the Army Weapons Office, the Air Force Ministry and the companies involved in production. The first production schedule, based on realistic possibilities, was drawn up, with the first examples mainly intended for further research and testing. Production was to begin in April 1943 with five missiles. In the further course this number should slowly increase to 10, 20, 60, 105, 200, 400 and 700 test specimens. It was assumed that a significant increase in production could only be achieved at the beginning of the following year. The still relatively small numbers were divided between three production factories: the main assembly line in Peenemünde, where the technical staff of private companies should gain experience, the Zeppelin works in Friedrichshafen and the Henschel factories in Wiener Neustadt. Mittelwerk GmbH, which was to take over the "Mittelwerk" underground facility (which previously served as a central storage location for fuel and lubricants), was not founded until September 24, 1943, t



The aisles in the middle section were high enough to hold the V2's main fuel tanks vertically

to set up. (Photo: Federal Archives, Koblenz)

Hitler demanded that production plans be doubled to 2,000 rockets a month, but the bombing of the Zeppelin and Henschel production plants made this all but impossible. The situation could only be saved by the gigantic Mittelwerk, in which around 3,000 prisoners from the Nordhausen concentration camp were already working at the end of September 1943 to produce the revenge weapons. A year later, that number had risen to 13,000.
In addition, production began in two underground factories in the Niedersachswerfen region near the towns of Lehesten (prisoners from the Buchenwald camp worked here) and Dernau (with prisoners from the Natzweiler camp).

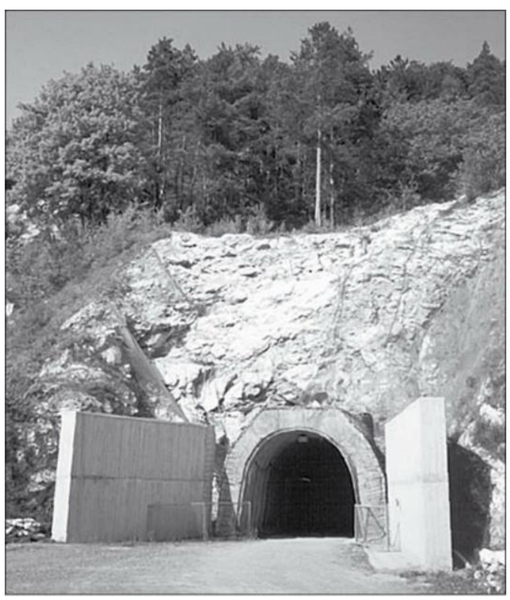
Mittelwerk, main transport tunnel. The railway tracks can be seen on the left. (Photo: M. Banaÿ)

During this time, Wehrmacht units were also intensively trained.
A long-distance missile school was set up in Koszalin, in which both officers and simple soldiers were taught primarily theoretical knowledge in a six-week course. An SS troop training area on Polish territory, a former artillery training area of the Polish army codenamed *Heidelager, was used for combat training.* It was near Blizna on the foothills of the Vistula and San rivers, about 150 km northeast of Kraków. By mid-November 1943, two artillery regiments with a total of six field batteries had been deployed there, each commanding three mobile launch pads.
The location of the practice area behind that for the

area of interest to Allied air forces seemed to guarantee safety. However, the Germans underestimated the fact that the rockets were falling in an area largely controlled by enemy partisans. It was precisely because of this that British intelligence, thanks to the Polish People's Army, got their hands on the first relatively detailed information about the construction of the V2. In truth, the amateurishly planned air raid on Peenemünde only revealed how little the Allies really knew about German rocket research (about 80% of the bombs fell outside the facility).

The experiments in inhabited areas offered the Polish People's Army ample opportunity for espionage. Missiles launched from the Blizna missile test site flew north and landed in an area near the town of Sarnaki near Platerowo.

Both Blizna and Sarnaki had been infiltrated by the intelligence of the Polish People's Army. The first example of a V2 detonated - to celebrate Hitler's birthday in April 1944 - near Sarnaki (between the villages of Mÿÿenin and Ogrodniki). However, the Germans quickly reached the impact site and removed all the debris.



Mittelwerk, today's entrance (Photo: I. Witkowski)

The resistance movement had long expected this. Already in 1943

she had a detailed map of the Blizna missile test site, which she had bought from a German employee for 2,000 Reichsmarks. She wanted to capture an entire missile and even considered robbing a transport train and "hijacking" a missile. However, a better opportunity soon arose. During the first days of May 1944, a V2 crashed into the Bug River without exploding. She didn't even suffer serious damage. During this operation, experts from Warsaw, led by Professor Groszkowski from the Warsaw Polytechnic, were even able to examine the electronic circuits (not even the valves were smashed!). It was decided to bring the recovered and disassembled rocket to England. On July 25, a DC-3 landed at a forest airfield near Tarnau and "snapped" the valuable goods "from under the noses" of German units stationed a kilometer away. It was relatively late, but before the missile was used in combat. 11,14,15,16,17 However, let's go back to the turn of 1943/1944.

In Peenemünde, however, research continued, mainly with the aim of reducing the technical susceptibility of the rocket to failure.
In addition, they wanted to change the design so that production could be made easier and cheaper. The updated plan called for the production of 200 experimental rockets in December and the first quarter of 1944 at rates of 300, 600 and 900 per month, respectively. But these requirements were not met either: only 56 rockets were produced by the end of January. In addition, the rockets that left the Mittelwerk were not complete. They lacked the electronics, which were only installed later in the DEMAG works in Falkensee near Berlin, and also the warhead, which was only assembled shortly before launch. The first production series also had serious technical defects.

The next "surprise" came after further test flights from the test site in Blizna. Apart from the fact that only one of the eight launches carried out was successful, it later turned out that the majority of the rockets, instead of falling into the intended target area, had already exploded a few kilometers above the ground. This was obviously an error that had not been discovered in the open sea trials - there was no way to do it there either. At that time, the impact point was determined by means of colored tarpaulins hanging on the surface

swim in the water. If they were in the expected zone, it was concluded that the flight was successful. In addition, no tests were carried out with a warhead, which is understandable given the number of rockets that fell in the area around Peenemünde or in the immediate vicinity of the plant. The result of the investigation was that the difficulties were caused by excessive heat stress on the skin of the center fuel section, which ripped apart, causing the liquid oxygen and alcohol tanks to heat up and explode. Since the rocket was already warming up in the dense layers of the atmosphere, the explosion occurred relatively close to the ground. To reduce stress, layers of glass wool were placed between the hull and the fuel tanks, which had the desired effect. The next unsolved problem was the sudden and unexplained engine failures during various phases of flight (usually shortly after takeoff). Here, it was possible to draw on the results of static research, which showed that the operation of the propulsion unit was accompanied by strong vibrations, mainly due to the engine.

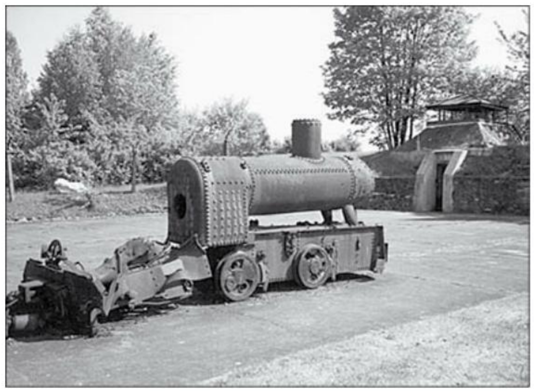
It was believed that this ruptured and severed the plumbing in the fuel system (including the jet cooling) and was then reinforced.

Only now could it be said that the V2 was at a technological level that allowed its military use. It was already spring 1944. The tests with the new approaches were no longer carried out at the Blizna rocket test site, as the Russian summer offensive had made this impossible. At the end of July, a new missile launch station codenamed *Heidekraut* was built in the Tucheler Heide, a few dozen kilometers east of the town of Tuchel. The research program was completed there. The first information that aroused the interest of the Polish reconnaissance and eventually led to the discovery of the site were reports from the local population about soldiers who occasionally wrapped themselves in sheepskins and wore thick gloves, even though it was the middle of summer. It later turned out that they were filling up the liquid oxygen tanks.

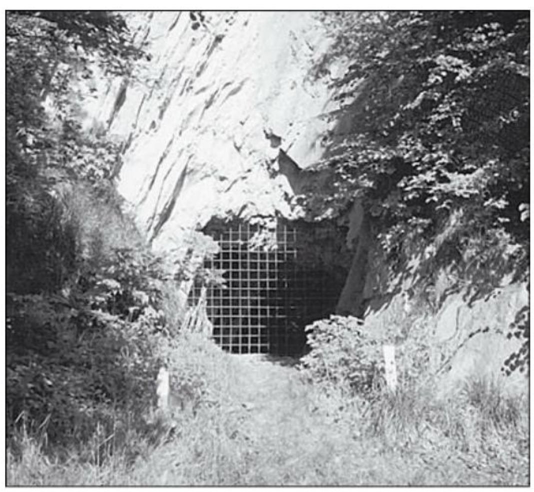
The year 1944 was a time in Germany when the SS continued to increase its dominant role and gradually gained control over

took over more and more institutions.

After the failed assassination attempt on Hitler in July 1944, Himmler repeatedly tried to gain control of the rocket program. The influence of the SS continued to increase. Since these actions were now endorsed by Hitler, they also led to success. SS Gruppenfuehrer Hans Kammler was appointed leader in charge of all matters relating to the A4 rocket. He retained this position almost until the end of the war, when, like many other high-ranking SS members, he "disappeared" under mysterious circumstances.



The remains of a narrow gauge railway used for transportation inside the underground factory. A penal bunker for the prisoners can be seen on the right. (Photo: I. Witkowski)



An entrance to the underground factory in Lesna (Marklissa) - one of the many places where components for the V2 were made. (Photo: I. Witkowski)

The data on the production of the V2 are incomplete. In Peenemunde

it is estimated that over 300 rockets were produced, and in the months of 1944 the Mittelwerk factories produced the following numbers: January - 50, February - 86, March - 170, April - 260, May - 440, June - 132, July - 86, August - 375, September - 629, October - 668, November - 662 and December - 613. In the first two months of 1945, 600 - 700 rockets were produced each, and in March, the last month of production, about 400.

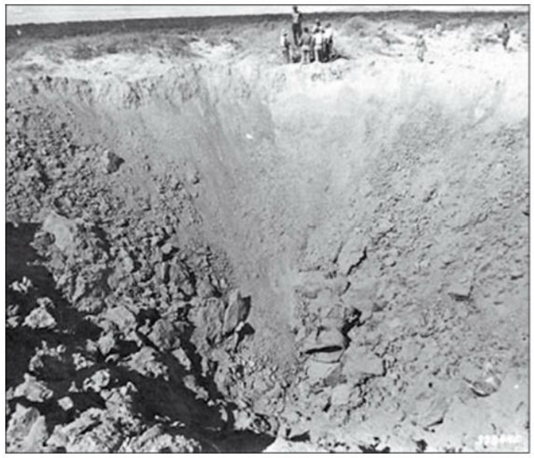
Initially, the Germans planned military operations solely from large bunkers protected from air attack, believing that such a complex weapon system as the V2 would require an extensive infrastructure of workshops and facilities essential for operational preparation. Military operations from the open field could not (wrongly) be imagined. In August 1943, on Hitler's orders, construction began on four huge bunkers along the English Channel: the "Kraftwerk Nordwest" at Watten, the "Schotterwerk Nordwest" at Wizernes (in the region of Calais), the "Reservelager West" nearby of Soterast and the "Oil Cellar Cherbourg" in Hainneville (both in Normandy). The latter was eventually repurposed into a V1 launch pad.

They were gigantic, completely self-sufficient bunkers, but they were easy to spot during construction. These fears were confirmed when, between the summer and fall of 1943, the Allies launched around 100 attacks on the facilities, dropping tens of thousands of tons of bombs. Under the total air supremacy of the Allies, it was considered unrealistic to be able to hold the bunkers despite their five meter thick walls.

Therefore, it was decided to launch all missiles from mobile ramps and focus on effective camouflage rather than protection from bomb blasts to put.

When SS-Gruppenfuhrer Kammler took command in August 1944, 45 camouflaged bases, 20 different depots and a number of fuel production and storage facilities were in place.

The Normandy landings, even before the first missile launches, forced the Germans to move them further north.



The crater caused by a V2 explosion on the ramp - at White Sands Missile Range after the war. (Photo: US Army)

Hitler gave the order to begin the attacks on September 15, 1944. Unlike the V1, whose launch equipment was large, immobile, and easy to detect, the V2 could rely on small movable launch platforms that were virtually undetectable. The rockets could therefore not only be launched from carefully selected positions, but also from roadways, forest clearings and any other accessible places protected from enemy military columns

were.

In contrast to the V1, the V2 was not only indestructible in its final flight phase due to its high speed of around 3,500 km/h, but also extremely difficult to detect shortly before launch thanks to the high mobility of the rocket ramp. The average flight time from the west of the Netherlands, where most of the rockets were launched, to London was around five minutes. 60-70 seconds after takeoff, the engine cut out at an altitude of about 35 km. In ballistic flight, the missile continued to climb to a maximum altitude of approximately 100 km. The V2 was the first space rocket.

Using a simple navigation system (gyro only), the spread, that is, the degree of deviation from the designated trajectory, ranged up to 20 km. Using a beacon or an inertial navigation system (gyro plus accelerometer plus flight line calculator) allowed for a 5- to 10-fold reduction in dispersion. This last option was originally used against

Standard military targets constructed and used in the late phase of operations against targets in Belgium and France.

In contrast to the V1, the warhead of the V2 only detonated after it had hit the ground. In the case of an impact on an open area, the damage caused was usually not great, but a direct hit on a specific structure - such as a building - almost always resulted in complete destruction. This happened, for example, when a London underground station used as a shelter was hit directly, killing over 1,000 people instantly. If the warhead exploded inside a building, it literally ripped it apart, damaging surrounding buildings as well. The first two missiles were launched towards London on September 9, 1944, and the number of attacks steadily increased. The number of targets also increased over time, from the end of September cities in Belgium, France and the Netherlands were also attacked.

As of October 3, a total of 156 V2 rockets had been launched, 52 towards the UK (London: 30, Norwich: 22), 42 towards Belgium (mostly on Liege: 17 and Hasselt: 10), 45 towards France (mostly on Lille : 15 and Paris: 10) and 17 to the Dutch city of Maastricht.

On October 12, Hitler gave the order to direct all rocket attacks on London and Antwerp.

By the end of military use of the rockets in late March 1945, no fewer than an estimated 3,170 V2 rockets had been launched, of which the majority of 1,610 rockets were aimed at Antwerp.

Second on the list of targets was London with 1,359 missiles.

A total of 1,664 were fired at cities in Belgium, 1,400 at Great Britain, 73 at France and around 20 at the Netherlands.

Based on conservative estimates, it can be assumed that about 70% of the missiles launched reached their intended target.

However, the arsenal of V-weapons is not yet exhausted.

Essential tactical and technical details of the V2 rocket (version B)

takeoff weight:	12,700kg
Weight without fuel:	4,008kg
warhead mass:	1,000kg
Length:	14.04m

Fuselage diameter: 1.65 m	
Maximum engine thrust: 25,200 kg	
Range: approx. 300 km	

The V3

The V3, the Third Reich's next "vengeance weapon," embodied a completely different concept than the V1 and V2.

The V3 was a long-range gun and a true pioneering project from a technical point of view. Unlike the other "vengeance weapons," Hitler thought highly of them from the beginning to almost the end of their short lives. The main developer of the V3 was engineer Coender, technical director of Röchling Eisen- und Stahlwerke. 3.9 Basically, the Germans

pursued the goal of increasing the range by increasing the muzzle velocity of the projectile. This was to be accomplished by maintaining a high pressure in the barrel of a long gun barrel, not only during the initial phase, but also throughout the firing process.

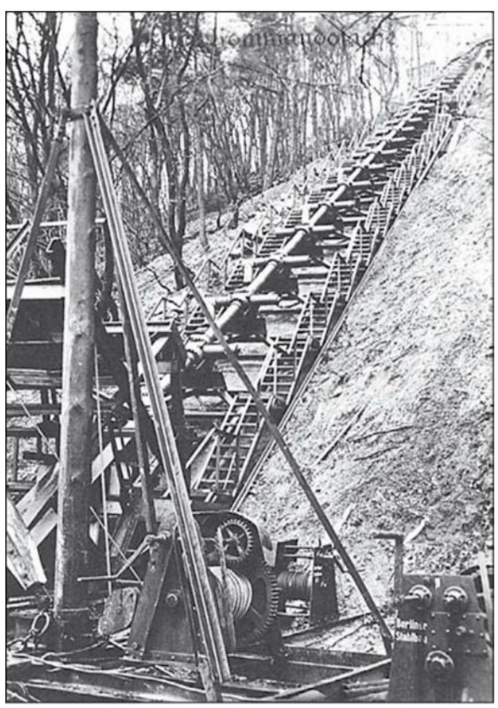
This could only be achieved by continuously igniting a powerful powder charge or by attaching several powder charges which would have to be ignited depending on the movement of the projectile within the barrel. The V3 worked exactly on this second principle. The ignition charges were placed in special side chambers along the entire length of the tube. Only the first charge was conventionally ignited behind the projectile.

The V3 was a so-called multi-chamber cannon, officially christened by the Germans with the code name of *Hochdruckpumpe .* Due to its shape, it was also unofficially called the *centipede .* The 150mm caliber gun was built to fire on just one target: London.
For this reason, and because of its length and generally complicated construction, it had to be built on a solid reinforced concrete foundation so that its gun barrel was permanently oriented at an elevation angle. The idea of such a construction had already been born in France at the end of the First World War, in response to the so-called Paris gun; however, it was not implemented in Germany until a quarter of a century later.

In May 1943 Speer initiated a meeting with Hitler, to which he appeared with the owner of the Röchling works, Hermann Röchling, to present Hitler with the draft of the new "retribution weapon". Hitler immediately liked the concept and demanded that prototypes be built. It was planned to eventually use 25-30 units in combat, operating at a total rate of fire of 300-600 rounds per hour.

The V3 was a smoothbore gun. It was also the first gun for which small caliber projectiles with in-flight fin stabilization were developed. Standard tank ammunition is still based on this principle today. The projectile had a diameter of 100 mm, a length of 2.5 m and weighed 140 kg - 25 kg of which was an explosive charge.

The projectile was oriented within the barrel using fins attached to the rear of the projectile. In addition, elements attached to the front third of the missile ensured stabilization within the long barrel - the so-called "clog", which was dropped after launch. A short sealing cylinder was placed behind the projectile, which acted as a piston. A firing range of about 160 km was planned. Prototypes were to be installed at two special firing ranges: in Hillersleben, about 20 km northwest of Magdeburg, and on the Polish island of Wollin near Misdroy.



The first version of the V3. (Photo: Federal Archives)

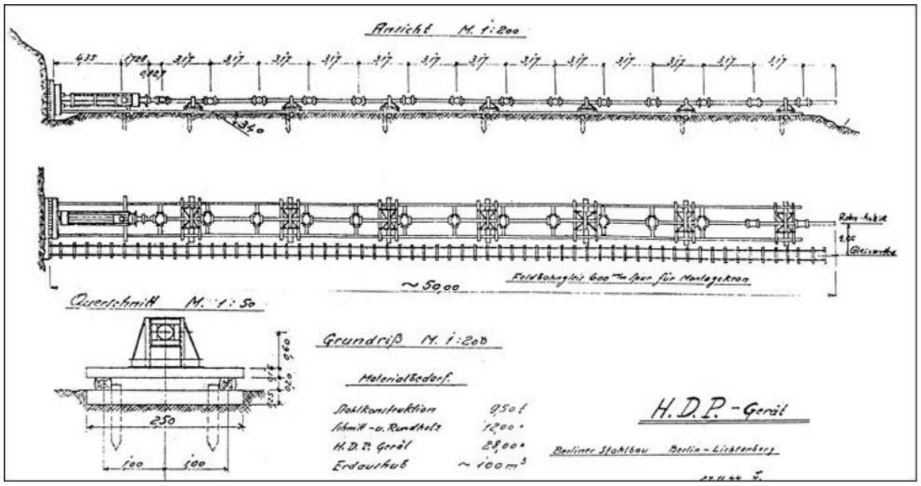
Due to increasing problems with the V1 and V2, Hitler's interest in the weapon increased. At a meeting with Speer in August 1943, he called for a combat site to be designated, although up to that point not even a prototype had been tested. It was decided to construct a large underground bunker near the town of Mimoyecques in north-western France, which would house ten battle batteries, each with five guns. The distance from this base to the center of London was 153 km.

In autumn 1943 the first parts of the *centipede* were assembled in Hillersleben. The first tests took place in October, but they could not provide any reliable information for future combat versions. At the same time, trials with a 20mm miniature of the gun took place, but with similarly modest results. The first full-length prototype was not completed until the beginning of November in Hillersleben. In January 1944, a second test gun followed in Misdroy, Poland. The firing of small caliber projectiles began immediately.

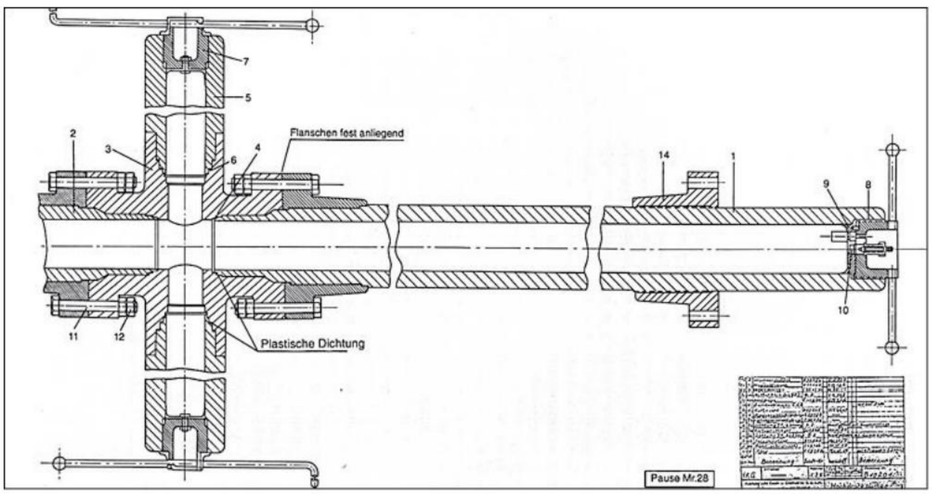
The successful construction of the projectile was confirmed and paved the way for an increase in production to 10,000 pieces per month. However, the construction of the cannon itself had not yet been fully checked, as only reduced powder charges had been fired up until then. Despite all this, the mood was optimistic, and Hitler was convinced that the hopes pinned on the V3 were fully justified.

It was not until March 1944 that it became apparent that these hopes were a little premature. In full, the gun consisted of 32 segments with a total length of 130 meters. When all chambers were filled with reduced gunpowder charges, the projectile reached a muzzle velocity of about 1,100 m/s. However, in order to achieve the desired range, a muzzle velocity of 1,500 m/s was required, which was to be achieved with the full charge.

But serious problems arose with this.



A German design drawing of the V3 from November 1944.



Original technical drawing of one of the sections of the V3.

It put the ability that the durability of the gun barrel sections was simply too low. Many sections were simply torn apart when fired. From today's perspective, it can be said that the pipe could not have withstood the prevailing pressure. This would have required a layered tube, which would have had to be manufactured using the autofrettage process. In this way, a better load distribution and even greater durability would have been achieved than was required for the *centipede .* During World War II, however, this technology was still in its infancy.

The next problem was the lack of accuracy. It was found that the projectile was not stable at the high speeds in flight.

Up until now, the Germans had manufactured around 20,000 projectiles. Hitler was now taking his revenge on Röchling, who had insisted from the outset not to inform the Army Weapons Office of the existence of this project until tests had been carried out. He had feared that the military would be hostile to such an unconventional design and would reject it after simple consideration.
A project with obvious errors was approved for implementation without the expert review of experts. At least that was the conclusion reached by a group of military experts who later took part in the test launches with General Leeb from the Army Weapons Office. It was March 1944. The military was in favor of scrapping the project, which would certainly have been the case had Hitler not been so committed.

So the work continued. Although the Institute for Aerodynamics in Göttingen was commissioned to design a new projectile that would be significantly lighter, weighing around 80 kg, a smaller number of the original projectiles continued to be produced. It was decided not to inform Hitler of the extent of the numerous problems. In the meantime, important improvements have been made to the design. The side chambers were no longer mounted perpendicular to the tube, but at a certain angle. The projectiles have also been improved. Despite efforts, July's resumed launches at Mizdroy revealed further malfunctions. Almost a third of the pipe was ripped apart. Work continued although it was evident that the targeted muzzle velocity was not achievable. However, this only became clear once the gigantic combat bunker in Mimoyecques had already been completed.

At the same time, a special Wehrmacht regiment was on the island Wollin in the final stages of training to use the V3 guns.

A case of the V3 grenade as an American trophy. (Photo: US Army)

The regiment consisted of about 1,000 soldiers and was under the command of Lieutenant Colonel Bortt-Scheller. 18 The problems encountered in reaching target range did not mean that the project was finally doomed. At the same time, but probably independently, a new type of long-range ammunition was being developed and tested that could have cast the whole enterprise in a whole new light. Tests with this new type of ammunition were carried out in Hillersleben, among other places. It was an artillery shell with an additional ramjet engine. There were several versions of this so-called Trommsdorff bullet 20 including 105 and 150 caliber bullets. The latter corresponded exactly to the caliber, of the V3 "super cannon".

A closeup of the V3 prototype. (Photo: Federal Archives)

I don't know if there was any thought of combining the merits of both weapons, but it would have been possible. The Trommsdorff bullet will be described in more detail in one of the following chapters.

Aside from the fact that working on the V3 itself was highly interesting, the construction of the gigantic underground complex at Mimoyecques also provides a rather curious story. The construction was kept so secret that even the head of the Army Ordnance Office in Leeb stumbled upon the whole undertaking only by accident when inspecting fortifications on the coast of France in late 1943.

The Germans initially planned to place 50 guns underground, but ultimately settled on 25. 430 miners and an estimated 5,000 experienced workers from the Ruhr coalfield were assigned to the massive construction of the underground facility in the fall of 1943. The core of the complex consisted of five large tunnels, each 150 m long, which led into the mountain at an angle of 45 degrees. Five cannons were to be placed side by side in each of the tunnels. The Krupp company supplied the armored covers for the tunnel openings so that only the tips of the tubes protruded. In addition, it was decided to protect the entire surface of the mountain with a layer of reinforced concrete six meters thick. Together with the hard rock, it should protect the building against any weapon of the time.

The main complex of horizontal tunnels with storage rooms and a track lay at a depth of about 30 meters, a good 10 stories down. From this level, elevator shafts led down through which the ammunition was to be made available. At the lowest level, at a depth of 80 to 110 meters, there were other tunnel systems.

Directly above, only the muzzles of the 25 cannons and narrow ventilation shafts revealed the existence of the facility. Even two high-voltage lines from France led underground into the complex. The construction swallowed a total of one million tons of cement, steel and gravel. Nevertheless, it turned out to be quite destructible.

Here, too, Polish espionage provided invaluable support to the Allies, notably the groups of Major Grabowski ("Lille") and Wÿ. Waÿny ("Tiger"). Grabowski was commissioned by London to cut the power line leading to Mimoyecques. A combination of commandos was sent to support the mission (Raszka, Bronicki-ÿoziÿski, Fijak, Kral and others). There was a reference to a spot where the line was above ground. As the Germans repaired the electrical supply lines after each sabotage, it was severed a total of 16 times. However, these were only preliminary operations, because a devastating counterattack was already being planned in England.

On August 12, 1944, ie after the Normandy landings, an unusual "Liberator" (a *Liberator-type bomber)* rose from a base in Norfolk – on board ten tons of high-explosive explosives. He was commanded by Lieutenant Joseph Kennedy, brother of the future President of the United States. Before reaching the English coast, the crew should jump off with parachutes; then an aircraft escort should take over the controls via radio. In the end, the "liberator" should hit the V3 complex.

However, it never came to that. 28 minutes after launch, a flash from a huge explosion lit up the skies over Britain. The "liberator" no longer existed. It was never clarified whether it was an accident or the result of German intelligence activities.

Shortly thereafter, an alternative plan was launched: the cannon complex was to be bombarded with the heaviest bombs of the time, the five-ton *Tall Boys.* It

should be the first combat use of these bombs. How much the British feared the V3 is shown by the fact that only a few weeks later the entire complex was attacked. One of the German witnesses to the bombing, Colonel Walter, recalled the effects of the first use of the "earthquake bomb":

> "It was as if the whole mountain was shaking and would collapse at any moment. Large and small stones rained down from the ceiling, everything cracked. Even people with strong nerves couldn’t last long underground.”

When Churchill later saw the construction at Mimoyecques he said:

> "From this place, London should have reckoned with the most decisive blow of all."

Let's remember that a warhead was supposed to fall on London every twelve seconds. Minister Sandys, future son-in-law of Churchill, later wrote to Churchill in a report on the V3 gun:

> "It could have been completed and used to shell London. As long as it exists, it poses a potential danger to England.” He recommended “the destruction of the bunker while our troops are still in France.” Apparently, the French didn't trust the British any more than the British trusted the French. Despite possible protests

from Charles de Gaulle, the British decided to demolish the Mimoyecques complex. On May 9, 1945, British sappers detonated explosive charges at several locations on the upper level of the underground complex - probably in the same way the Russians had attempted to destroy the Mittelwerk complex. A few days later, both railway entrance tunnels were blown up with 25 tons of explosives.

Despite this, most of the underground facility is probably still intact. Perhaps one day it will be possible to get inside and open this "sealed museum"? 3,9,18,19 The various derivatives of the "V" weapons, as well as numerous alternative designs, are a relatively unknown subject. Below is a brief summary.

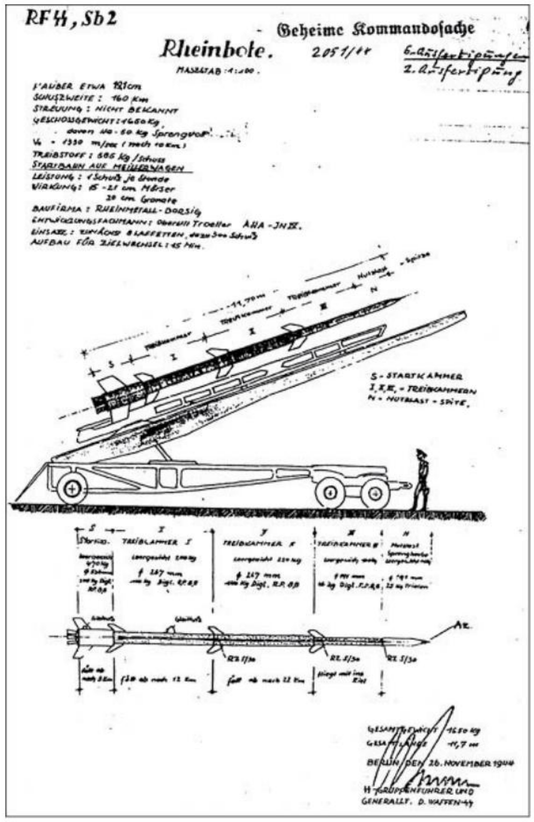
The Rhine Boat

Although the *Rheinbote rocket* presented below did not receive an official V numbering, it should still be counted as one because it represented an attempt to create a long-range solid propellant rocket rival to the V1 and V2.

It was an initiative of various designers at Rheinmetall Borsig. In June 1941, the artillery department of the Army Weapons Office commissioned the company to implement the plans. The project grew out of experiences in the late 1930s with solid propellant rocket engines and glider launch engines.

In the summer of 1941, Rheinmetall presented three designs for four-stage long-range rockets to the Army Weapons Office for assessment and selection. The lightest variant of the missiles was to have a weight of 1,750 kg, including 625 kg of fuel, a warhead of 200 kg and a projected range of 100 km. The 'medium' rocket would be twice as heavy at 3,500 kg, with 1,220 kg of fuel and a 500 kg warhead. The estimated range was 110 km.

The heaviest variant was a true giant in its rocket class for the time and was comparable in size to the A4. The Germans envisaged it to have a take-off weight of eight tons, 2,800 kg of fuel, a 1,250 kg warhead and a range of around 120 km.



A German document with the first drawing of the *Rheinbote rocket.*

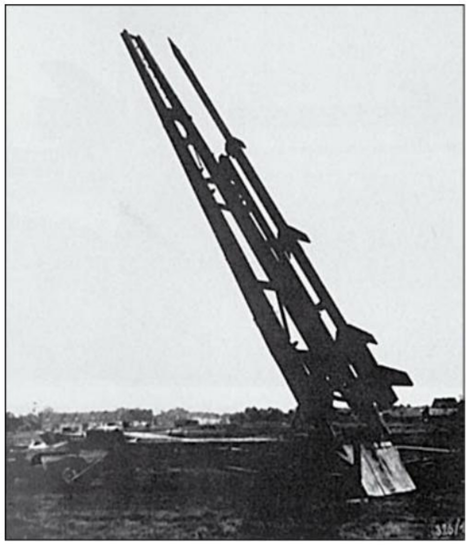
However, Wehrmacht officials, and especially Dornberger, were rather skeptical about the whole project. The military usefulness of the missile has been questioned mainly due to the high consumption of scarce fuel and the missile's projected poor hitting accuracy.

Therefore, only the "light" variant was accepted for further implementation, also favored by the problems occurring at that time in the development of the A4 rocket. However, the decision fell in favor of significantly reducing the warhead mass to just 40 kg, as calculations showed that the range could be doubled in this way. This is exactly why the *Rheinbote* was classified from the outset as another "psychological retaliatory weapon" whose purely military use was not necessarily in the foreground. Since the missile had no navigation or guidance system, it could only have been used to attack large surface targets.

A closeup of the six nozzles of the main engine of the *Rheinbote rocket.* (Photo: Imperial War Museum)

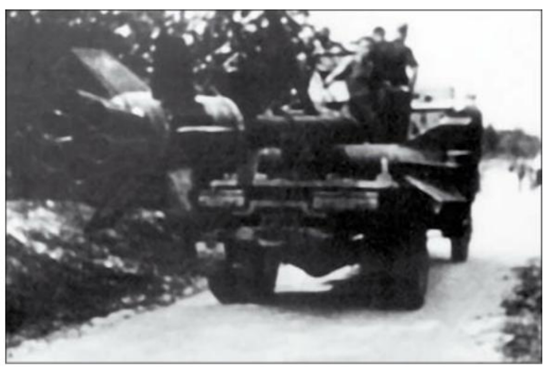
Their range, which roughly corresponded to that of the A4, also suggests that such a use was intended for them. A 40-strong research team was put together in the Berlin Rheinmetall factories to construct a prototype. The missile received the working designation Rh-Z-61. The first specimens were ready for range tests as early as November 1941, which were carried out at a facility on the Baltic Sea coast in Leba, Poland. This was an air force missile base, which was also called "Klein-Peenemünde" at the time and had already been used by Rheinmetall for tests with various air forces. The rockets were launched towards the island of Bornholm, 170 km away, which was occupied by the Germans and on which evaluation devices were installed.

Initially, however, only individual stages of the rocket were fired independently. Material procurement problems (the project had not been given priority) meant that no complete rockets could be tested by April 1943. The tests were considered successful, and the final stage of one of the rockets even fell down near the observation post on Bornholm, allowing it to be examined later.



The *Rheinbote* in firing position. (Photo: German Museum)

Although the *Rheinbote* was still not assigned to any major armaments program and was therefore not given priority or sufficient raw material supplies, the research group managed to unofficially "organize" the materials from the long-range missile program to build the next 30 prototypes.

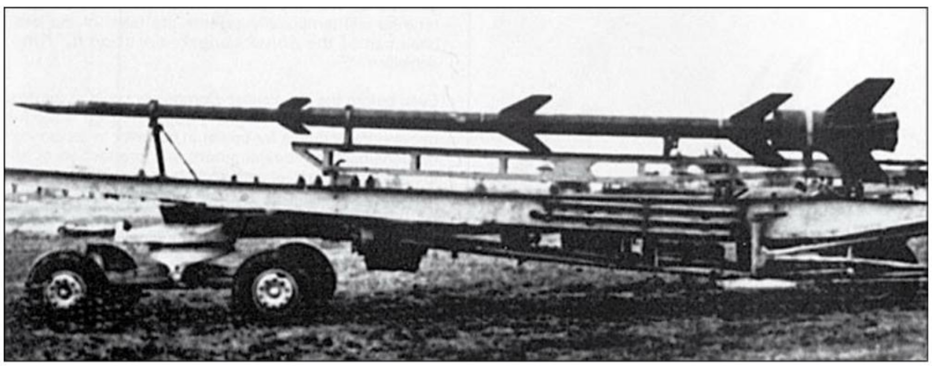


A unique photo showing the *Rheinbote* dismantled for transport. (Photo: Imperial War Museum)

For reasons that are not clear, the rocket parts were not delivered until the beginning of 1944, and in the wrong dimensions. Due to the considerable delays, it was decided to speed up the work significantly. Production of the first batch of 200 missiles was commissioned. A special artillery unit was created, training for which took place in Leba. In the meantime were

Conducted rocket tests, which, however, revealed fundamental malfunctions in all fired rockets. The problems were caused by irregular burning of the powder, which in several cases caused the rocket to explode. There have also been cases where the fins broke off once the speed of sound was exceeded.

It was not until the end of 1944 that the research group was able to overcome the problems. Just as with the V2, the SS took control of the Rheinbote project after the failed assassination attempt on Hitler in Rastenburg on July 20 . Surprisingly, despite the skepticism of the Heereswappenamt, Kammler and other SS officers became enthusiastic supporters of the new rocket. The flight test site was moved from Leba to the Tucheler Heide (Poland). By mid-December, just 100 rockets had been produced.



The *Rheinbote* on the rocket launcher. (Photo: Deutsches Museum).

A further 220 were to be delivered by the end of January 1945. At that time, attempts to improve the rocket continued, but the results were still far below expectations. Of 12 rockets launched in the first half of December, five all but failed, mainly due to explosions. The rest showed a considerable spread of 50 to 160 km.

Parts of the *Rheinbote rocket that* exploded after launch near the test site in Leba. (Photo: I. Witkowski)

Although the *Rheinboten* were immature, some (the experimental series) were used in combat operations on the western front. The only confirmed action took place during the Christmas season of 1944: a few dozen fired on Antwerp from a distance of 165 km.
However, calculation errors caused them to fly over 220 km! Since the project was controversial, not very successful and, moreover, did not promise any particular benefit, it met a similar fate as the ill-fated multi-chamber gun.

On February 6, SS-Gruppenführer Kammler decided to stop the work. 3

Essential tactical and technical details of the ***Rheinbote missile***

Total weight: 1,656 kg Weight of individual	stages: I -
710 kg, II - 380 kg, III - 360 kg, IV - 166 kg	Warhead mass: 40 kg Overall length: 12.9 m Maximum flight
speed: approx. 6,000 km/h Thrust duration	(total): Range:
	approx. 15 s
	200-230km
flight altitude:	70 km

Other Vengeance Weapons

The presented long-range weapons projects testify to the enormous scientific and productive potential of the Third Reich. These weapons and in particular the V2 set the world with their modernity and

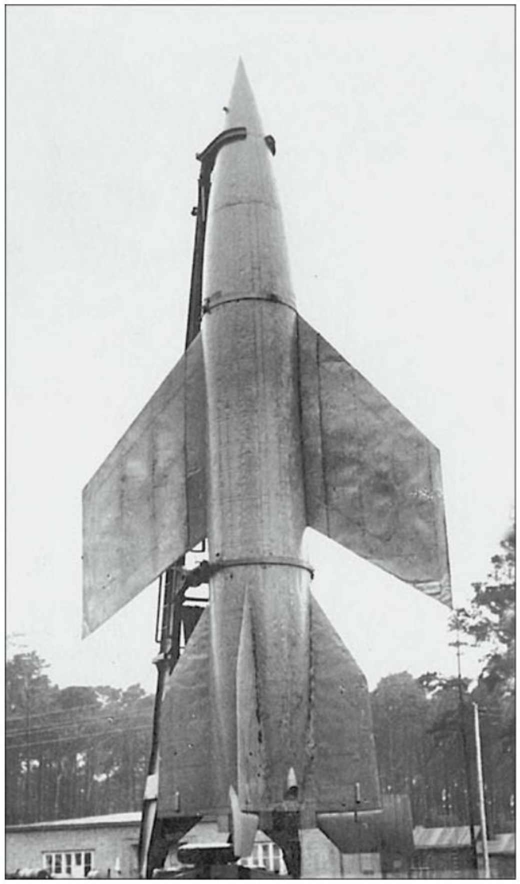
Innovation in amazement. In many cases they, and especially the V2, were further developed and perfected after the war in other countries such as the USA, France or Russia. But the German program from which they emerged had even more to offer. There were numerous other projects, but in most cases they only made it to the prototype. They were even more revolutionary and belonged to quite simply the most interesting group of weapons developed during the Second World War.

In which direction did the work go? After the lack of effectiveness of the "vengeance weapons" had been realized, not only an increase in range was sought, but also great importance was attached to improving accuracy. Analyzing these even more advanced projects, it becomes apparent that the Germans had no intention of limiting their "retaliatory attacks" to European territory only.

Attempts to implement the stated goals were initially undertaken in connection with the already existing weapons. This first manifested itself in the modernization of the V1 rocket, of which a version with a longer range and flight speed was produced. In 1944 an order was placed to manufacture a new jet engine for the V1. BMW and Porsche presented their designs. With this engine, the range would have been increased to 500 km. With a flight speed of 800 km/h, it would also have been an extremely difficult target for British fighter planes. In addition, the Germans planned to equip the rocket with a remote control system similar to that already used in guided aerial bombs. The missile was to be fitted with a camera installed in the nose section, which would transmit images of the target via a radio transmitter. A receiver should receive the control commands via the same signal path. This version would have been a "real" cruise missile that could have hit small targets with precision. In the spring of 1945 intensive efforts were also made to install a beacon for the first phase of flight, similar to that used on the V2. The V1 was also to be the first "vengeance weapon" the Germans intended to use against the United States.

A suicide version of the V1 (the Fi-103 Re.4, without the nose section). (Photo: Imperial War Museum)

There were even plans to equip the most advanced Type XXI submarines with V1 launchers, but the Germans failed to do so either. However, an unknown number of V1 launchers were fitted to older submarines. The *Elster* mission in 1945 attempted to use them against America, but the mission turned out to be a fiasco. According to some intelligence reports, American countermeasures were so quick and effective because Americans feared the missiles were carrying biological warheads. It was April 1945 and the last attempt to realize Hitler's great dream - or rather nightmare - had failed: the destruction of New York, the "capital of Jewry". The *Ursel* unguided rockets , developed in Peenemünde in 1942, served the same purpose, but it is not known if they were ever used. 3,22,23

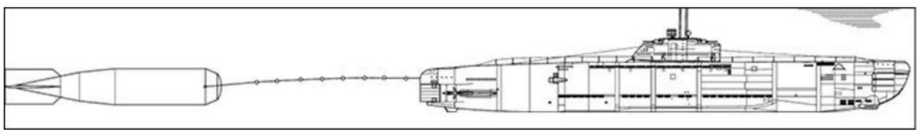


The A4b rocket in early 1945. (Photo: Deutsches Museum)

Toward the end of the war, the dying Third Reich, in an act of desperation, planned to convert some V1 rockets into suicide planes by installing a cockpit, which the pilot would direct to particularly important targets. However , this version of the V1, known as the Fi-103 Re.4 *Reichenberg,* met with opposition from the Luftwaffe leadership, who called the design a "suicide plan for the Luftwaffe". Even Hitler treated the plan with extreme reluctance. Nevertheless, pilots were trained in handling the missile and 175 examples of the Suicide V1 were built. However, they were never used. The main purpose of the training was to gain additional information about the flight characteristics of the rocket.

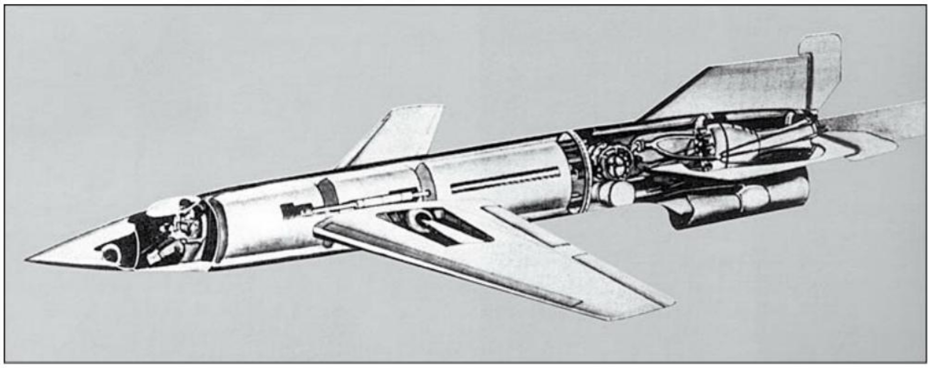
An extensive program was also set in motion for the further development of the V2. The Germans also wanted to use this weapon against American cities. For this purpose, "underwater silos" codenamed *life jackets* and a water displacement of 500 tons were developed.

Each housed a rocket, engineering equipment, and a cabin for the crew. After the launch preparations, the crew should leave the silo just before the automatic launch of the rocket. A new Type XXI submarine could have towed up to three such silos behind it. However, the plans were scrapped because there was no way to control the location of such a floating launch device.
However, it would have been possible to determine the exact coordinates of the target - in the last months of the war, American counterintelligence fell into the hands of a group of German agents who were carrying beacon transmitters. By the end of the war, however, the shipyard in Elbig was only able to produce a single silo.



A silo with the V2 missile towed by a Type XXI submarine. (Drawing: M Ryÿ)

A new, far more revolutionary missile with an even longer range was developed on the basis of the A4. This was a completely new design, although the name A4b given to it suggests that it is "only" a descendant of the A4. The name was chosen to ensure resources for conducting experiments. The A4b was intended to have a longer range, mainly through the installation of...wings. After the phase of ballistic flight, it should switch to gliding flight and thus achieve a range of 600 km. To improve control while gliding, her rear stabilizer has been enlarged and aerodynamic control surfaces have been added. In flight, the A4b, like the A4, was controlled by graphite controls that deflected the flow of gas from the nozzle. In December 1944 it was decided to build 20 prototypes of the rocket.



A manned version of the A4b with an additional engine. On their basis, the manned version of the A9 was developed. (original drawing)

Although the first two launches failed, work continued. The first successful start finally took place on January 24th. Everything looked promising until during the transition to gliding flight one of the wings broke apart, meaning that the planned range was not achieved. A cockpit version of the A4b was also developed. This even had a retractable landing gear and an additional small engine to increase the flight range. However, this version never made it past the paper stage.

Although no flight tests were undertaken with the A4b until 1945, production plans for it had existed for some time. The concept of the A4b was developed almost parallel to the work on the A4. On the basis of this project, work had been going on since 1941 on an even more groundbreaking rocket called Aggregat 9 (A9), which was to be equipped with a new type of aerodynamic system ("Delta") without tail fins. Even then, the Germans were planning to use them as the second stage of the still-in-development A9/A10 rocket ("Amerika rocket"), which was intended to destroy the most important cities in North America. However, this version of the A9 was not intended to hold a ton of explosives, but to carry a massive nuclear payload. General Dornberger wrote the following about the work on the A9 in his memoirs:

> "[...] Hundreds of calculations were made to determine the trajectory that would allow the longest range. Ultimately, it was determined that the rocket should reach a maximum speed of 4,500 km/h at a maximum altitude of 19 km and then transition to a slightly inclined trajectory whose

crest height would be almost 29 km. After reaching the target area, it would then dive at an altitude of 5 km like the Fi-103 (V1).

We were just one step away from developing a piloted version of an unmanned A9 missile with a fully automated guidance system. This extremely fast aircraft with wings measuring only about 13.5 square meters had no military significance. Special wing flaps allowed it to land at a speed of just 160 km/h, having previously covered about 640 km in just 17 minutes. However, the development of the A9 could not satisfy our ambition. We wanted to cover an area of several thousand kilometers. In fact, our own private and exclusive area of activity only began beyond the reach of the heaviest aircraft.

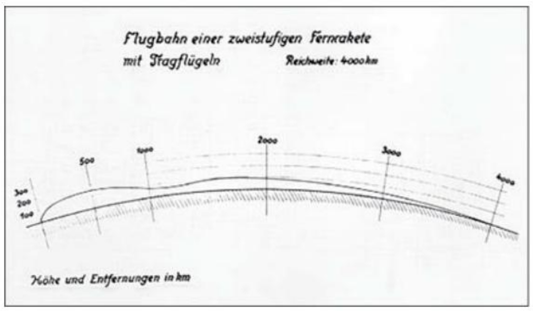
It was only by abandoning the single-stage system in favor of a multi-stage rocket, ie by jettisoning the 'dead' mass that had already done its job and thereby improving the rocket's weight ratio, that we could hope to achieve such an incredible increase in range.

So this was the origin of the A9/A10 project. The aim in this case was that the second stage (A9) engine should only start to work and thus serve as an auxiliary drive after the rocket had reached a sufficiently high speed via the first stage.

An alternative would have been a catapult, giving the A9 a sufficiently high initial speed. Based on calculations and practical experience with the V1 launch pads, a long, sloping catapult was designed that could accelerate the A9 rocket to an initial speed of 1,290 km/h. This speed would have been sufficient to allow the fuel-filled rocket to start smoothly afterwards.

A better plan, however, which significantly increased the range, was to build the A10 - the first stage of the A9/A10 system - which would have weighed 87 tons with a total fuel mass of 62 tons.

The A9 was superimposed on the A10, which would then have given the A9 an initial speed of 4,350 km/h with a 50-60 second sustained thrust of 200 tons. After the first stage fuel stores were exhausted, the A9 engine was scheduled to start and separate. Soon after, the climb angle of the A9 should increase to reach a maximum altitude of 56 km. Then a long glide at supersonic speeds should begin."



An original drawing of the trajectory of an A9/A10.

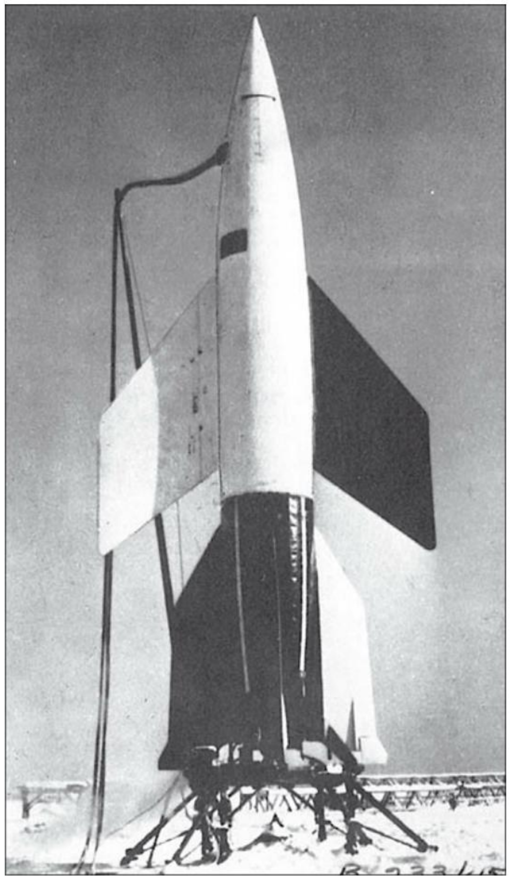
The Germans wanted to achieve a range of about 5,500 km with the basic version. For understandable reasons, the only armament variant should be a nuclear warhead. The A9 missile program was the first venture to directly combine a long-range transport vehicle with a nuclear weapon. Work on this construction in the Third Reich was almost complete. Effective use of this missile, however, required a new approach to what remains a major problem today: accuracy. At the time, the problem presented an even greater hurdle that seemed insurmountable, even given the warhead's radius of destruction and the size of the New York or Washington metropolitan areas. The Germans planned to solve this problem with a manned version of the A9, similar to the manned version of the A4b. The missile was to fly over the Arctic and approach the American east coast from the northeast. The pilot was supposed to fly at high altitude all the time, drop the nuclear bomb at the target and continue the flight south alone with the auxiliary drive and finally land in Argentina, which the Germans traditionally found peaceful

was minded.[24.25]

Formally it was a neutral country, but in reality it cooperated closely with the Third Reich. This close bond was due in particular to the Argentine military attaché Juan Domingo Perón, who was in Berlin at the time and was to become Argentina's president.
Thanks to him, Argentina was at the service of the German “special weapons” program after the war, because on his orders diplomatic missions in Austria and Italy issued around 2,000 passports in 1945-1947, which enabled the evacuation of many persecuted people, including scientists with valuable documents about new weapons.

However, the problem of accuracy was not as great as it might seem from today's perspective. The trajectory correction in the last stage of the flight could also be accomplished without a pilot. on the 30th
For example, on November 19, 1944, as part of Operation *Elster* , U-1230 brought a group of agents equipped with beacon transmitters to the United States.

However, let's return to the A9/A10 project.



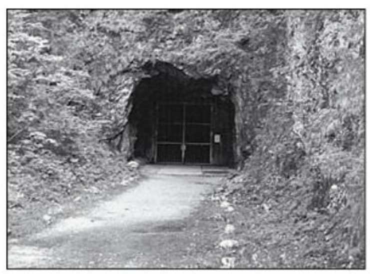
The A4b in January 1945. (Photos: Deutsches Museum)

The Germans did not manage to complete a prototype until the end of the war. However, the entire theoretical work, which had already begun in 1941, as well as the complete documentation in the form of technical drawings, was completed. dr Thiel, who later died in an air raid, and Dr. Walter had proposed six well-engineered engines from the A4 with a combined thrust of 180 tons to drive the

to use A10. Later, however, it was decided to develop a single engine with a thrust of 200 tons. In its final version, the rocket was supposed to reach an altitude of 180 km within a minute.

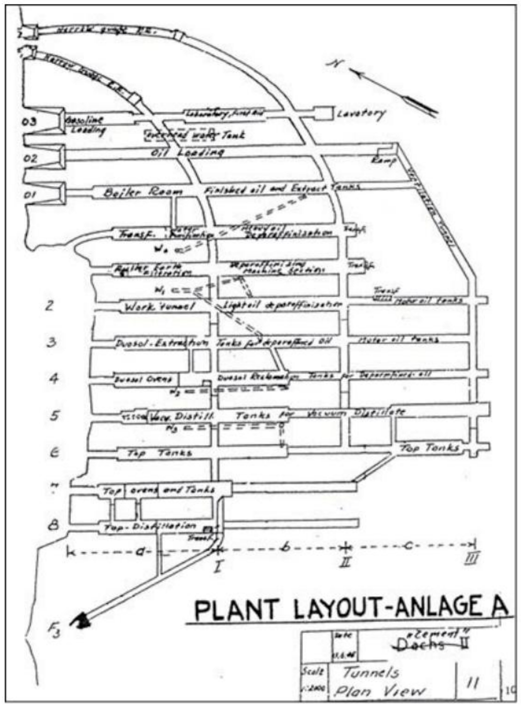
For the research and production requirements of the A9/A10 project, construction of a huge, multi-storey underground complex code-named "Cement" began under SS direction at the end of 1943. This factory, with a total area of 65,000 m2 , was located under a mountain massif on Lake Traunsee, near the town of Gmunden in north-western Austria. About 3,000 workers should be employed there. Test stands for the new engines and launch pads for the rockets were to be set up in a neighboring valley.

If completed in time, the “America Missile” would have been the first “retribution weapon” that actually had a chance of significantly influencing the course of the war. 7,21,24,25



One of the entrances to the "Cement" facility. (Photo: I. Witkowski)

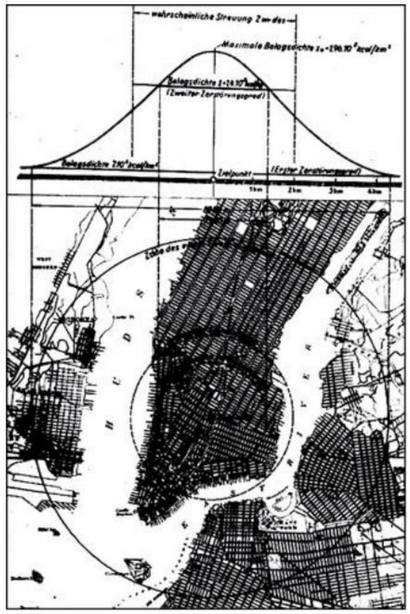
"Cement" - one pass. (Photo: M. Banaÿ)



General plan of the "Cement" Annex - Annex A. (BIOS)

In concluding this discussion of German long-range weapons projects, one cannot avoid emphasizing their influence on the history of arms competition and their importance for the course of the Second World War.

From today's point of view, these projects had a very large impact on the general development of military technology.
Paradoxically, their influence on the course of World War II is the other way around.



This diagram from 1944 shows the radius of destruction of an A9/A10 nuclear warhead. In the center is Manhattan. (original drawing)

In particular, the wrong strategic decisions and the limited potential of these weapons due to the high dispersion contributed to this. Of the models used in combat, only the "precision version" of the V2 with inertial navigation system and additional beacon could in reality have threatened many important facilities, but its potential was misused.

Only certain weapons, which the Germans were never able to put into mass production in time, had real and significant military potential - such as the V1 version with a new engine and camera remote control system or the A9/A10 rocket. In practice, there was a huge mismatch between the amount of resources used and their impact on the military situation. The maxim "small resources, big effect" promoted by Hitler had turned into the principle of "huge resources, small effect" in reality.

In his "Memoirs" the Reich Minister for Armament and Munitions, Albert Speer, attempted to trace the internal history of these operations:[1]

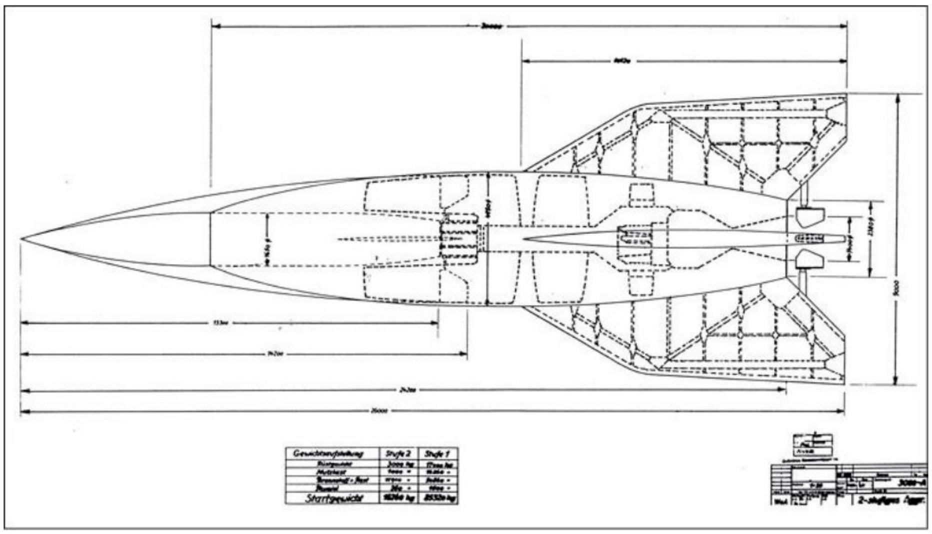
> “Again we came two years too late. The Russian winter offensive had led to our troops retreating; the situation was critical

become. Hitler, astonishingly short-sighted as so often in emergencies, explained to me at the end of February that the 'Master Corps' had been ordered to destroy railway lines in order to stop Russian supplies. My objections that the ground in Russia was frozen hard, that the bombs could only have a superficial effect and that, in our experience, the much more sensitive German railway lines were often restored after hours: all remained fruitless. The 'Korps Meister' was used up in a pointless operation, of course without being able to impede the operational movements of the Russians.

Hitler's further interest in the point strategy idea was also sapped by his stubborn retaliatory intentions against England. Even after the 'Korps Meister' had been destroyed, we would still have had enough bombers for such plans. Hitler, however, entertained the unreal hope that a few massive attacks on London would persuade the English to abandon their offensive air warfare against Germany. That was the only reason he was still demanding the development and production of new, heavy bombers in 1943. That they could find far more worthwhile targets to the east. i.e. Autors: Key parts of Soviet industry were concentrated in huge, monopolistic behemoths] made no impression on him, although he occasionally, even as late as the summer of 1944, agreed with my arguments: he, like our Luftwaffe staff, was incapable of conducting an air war in terms of technology rather than in terms of technology outdated military viewpoints. The other side initially also […]

It was Hitler again, despite all the tactical mistakes of the Allies, who made the moves that helped the enemy's air offensive in 1944 to succeed: he not only inhibited the development of the jet fighter and later had it transformed into a fighter-bomber - he wanted to also take revenge against England with the help of the new large rockets. On his orders, from the end of July 1943, enormous industrial capacities were occupied for the long-range rocket known as the V2, which was 14 meters long and weighed more than 13 tons, of which he produced 900 pieces a month

wanted to. It was absurd to retaliate against the enemy bomber fleets of 1944, which for several months dropped an average of 3,000 tons of bombs per day with 4,100 four-engine aircraft on Germany, which would have transported 24 tons of explosives to England per day: the bomb load of an attack by only six flying fortresses.



A cross section of the A9/A10 rocket. Placed vertically on the launch pad, the rocket was as tall as a ten-story building.

It must have been one of my gravest mistakes in directing German armaments not only to have approved of Hitler's decision, but to have endorsed it - when we should have been concentrating our efforts on the production of a surface-to-air defense missile."

Tactical and technical details of the A4b missile

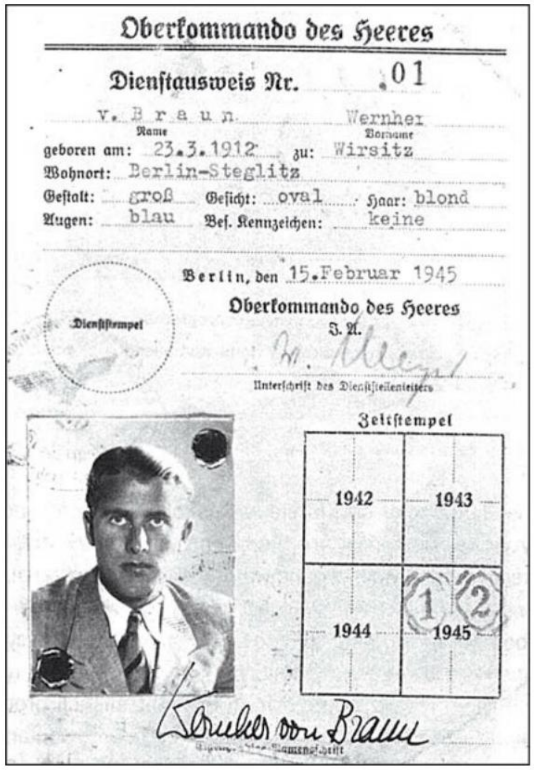
takeoff weight:	13,000 kg
warhead mass:	975 kg
Engine Thrust:	27,500 kg
Overall length: 14.06 m Fuselage diameter:	1.65 m
Wingspan: 6.2 m Maximum speed:	km/h 5,500
Range:	
	595 km

Tactical and technical details of the A9/A10 missile

	Version I	Version II
takeoff weight:	85,320 kg 100,000 kg	
Fuel mass Stage I:	51,700 kg 62,000 kg 6,810 850	
Mass of fuel Stage II:	kg 200 tons 200 tons	
Thrust Level I:		
Thrust Level II:	28.1 tons 28.1 tons	
Total length:	26 m	–
fuselage diameter:	4.15m	3.5m
wingspan: range	9.3m	–
(version without pilot): approx. 8,000 km approx. 8,000 km		
maximum flight speed: approx. 11,900 km/h - warhead mass:		
	approx. 1,000 kg approx. 1,000 kg	

In theory, at least, there was an interesting alternative to the “America Missile” that was developed under the code name *Thor’s Hammer .* 26 This was a so-called rocket-powered aircraft, or more generally: a space shuttle.

Already since 1936 under the direction of Dr. Eugen Sänger worked on this space shuttle at the rocket test center in Trauen, which he founded. It was the first specific design of a spacecraft capable of carrying a human crew above Earth's atmosphere.


Oberkommando des Heeres

Dienstausweis Nr. 01

v. Braun Wernher
Name Vorname
geboren am: 23.3.1912 zu: Wirsitz
Wohnort: Berlin-Steglitz
Gestalt: groß Gesicht: oval Haar: blond
Augen: blau Bes. Kennzeichen: keine

Berlin, den 15. Februar 1945
Oberkommando des Heeres
I. A.
Unterschrift des Dienststellenleiters

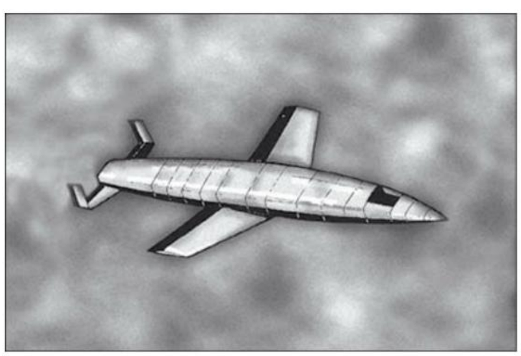
Dienststempel

Zeitstempel
1942	1943
1944	1945

Wernher von Braun
Eigenhändige Namensschrift

Wernher von Braun's military ID card.

Thor's Hammer , like today's Space Shuttle, was to have an unusually flattened fuselage to provide additional aerodynamic lift during acceleration and easier entry upon into the atmosphere. In addition, it should enable a subsequent gliding flight and thus ensure a long range. The hull was to be in the shape of a flattened spindle measuring 28 x 3.60 x 2.10 m. The crew's cockpit was supposed to be in the forward part, but completely hidden under the hull.



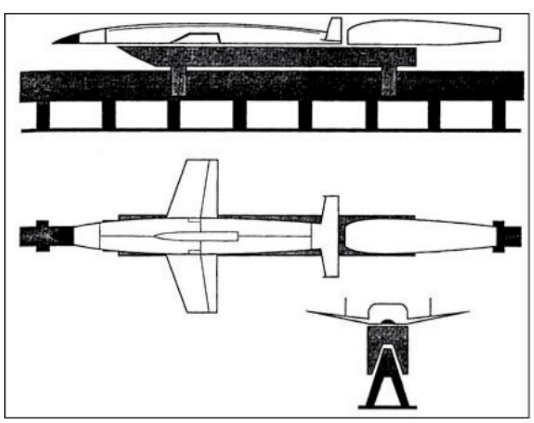
Thor's hammer (photo from the author's collection)

In all likelihood, a full-scale prototype was never completed, but it is known that assembly of a 1:20 scale model, intended for aerodynamic testing, began as early as 1938. Singer's design was originally intended for civilian use, but under pressure from the military, in 1939 he changed the purpose of the "spaceship" to a type of intercontinental space bomber that was to be powered by liquid fuel. Singer planned to use a massive rocket engine with a thrust of 100 tons and also two much smaller engines to be mounted on the sides.

The Me-264, the "America Bomber", was intended as an alternative to the "America Missile". (Photo: Federal Archives)

It may come as a surprise that this was a single-stage spacecraft, in contrast to the A9/A10 rocket and the American space shuttle, which have two additional separable solid propellant engines. However, this was not a mistake, but rather proof of the superiority of Sänger's design, because according to the plan, no components would have been necessary for the start, which would have been irretrievably lost. A launch pad was even designed, a kind of catapult or launch rail with a planned length of three kilometers. Even if that sounds like a gigantic construction, it would still have been shorter than the 3.6 km long runways of modern airports. The spacecraft was to be accelerated on the platform by a "launch module" that would have been significantly larger than the "bomber" itself, one

supporting launch unit, equipped with rocket engines and a thrust of 600 tons. These should operate for eleven seconds and give the primary object a speed of 1,850 km/h. The last section of the ramp had an incline angle of 30° and would have put the spacecraft in a climb right from the start. (Probably best would have been to build such a launch rail on the top of a mountain with a corresponding profile.) The engines would not have activated immediately after launch, but only after several seconds at an altitude of 1,200 m. They would have eight minutes of continuous propulsion, propelling *Thor's hammer* at a speed of 14,000 mph (22,110 km/h) to the point where it would have initiated ballistic flight at an altitude of 90 miles (145 km) above the Earth's surface. By that time all the fuel would have been gone. After bridging a few thousand kilometers, the space bomber would have begun to approach the thin layers of the atmosphere again. Only here could it have used its flat surface and small wingspan of 15 m. It would then have “bounced” off the layer of air and would have gone back into ballistic flight for a while. (The calculation of such a trajectory was still difficult even in the 1960s, when the Apollo spacecraft was being designed under the direction of Wernher von Braun. Had the landing module entered the atmosphere at too steep an angle, there was a risk that it would have burned up ; conversely, if the re-entry angle was too shallow, it could have been pushed back into space.)



Thor's hammer in launch configuration. (Drawing: B. Rduÿtowski)

A multiple "bouncing" would then have brought the following advantages: First, it would have increased the range. Secondly, this would solve the problem of the skin overheating as it would have been repeatedly cooled in the higher areas. In the final flight phase, the rocket plane would then have had a sufficiently reduced speed, so that this problem would not have exceeded the technical possibilities of the time. Third, each phase of the "low flight" offered the practical possibility of dropping a bomb. However, the possibility of using an atomic bomb was not considered until 1944.

After developing a preliminary draft, Dr. Singer set out to study structure heating from air resistance.
It is known that research work in this area was already at an advanced stage in 1939. Singer also worked on an engine with a thrust of 100 tons, but without much progress. This work was interrupted in 1942 because another team from Peenemünde was constructing an analogue engine for the A9/A10 rocket.

The Air Force
A time of searching

The Me-262

Of all the advanced missiles of the Third Reich, the Messerschmitt 262 had the greatest influence on the course of World War II. It was one of the few aircraft to make it into mass production and combat use from the masses of often unconventional aircraft.

While not the first jet aircraft, the Me-262 became in some ways a symbol of the huge leap in technology that took place in aviation and technology in general during the war.

A total of five jet engines were constructed in the Third Reich, four of them during the war. The BMW-003, which underwent several modifications in the period from 1941 to 1943, the Junkers Jumo-004, which is relatively analogous to it, and the slightly larger HeS-011 from Heinkel-Hirth. Compared to the Jumo-004, it had an increased thrust from 8 to 9 kN and was a further development of the not very successful predecessor HeS-08. Another engine would go into production in 1945, significantly larger and more modern than the previous BMW 018 engine.
However, that didn't happen. A thrust of 34 kN would have enabled the implementation of large jet bombers.
On July 27, 1941, the first BMW 003 engines were delivered.
They were fitted to one of the Me-262 prototypes, but both failed within seconds of the aircraft taking off. The entire program would certainly have been canceled if the Junkers factories, which were also working on jet engines at the same time, had not stepped in to the "rescue". They provided their latest Jumo-004 powerplant, which was similar to the BMW powerplants but slightly larger. Although the installation required some redesign of the engine nacelle and wings, these measures turned out to be

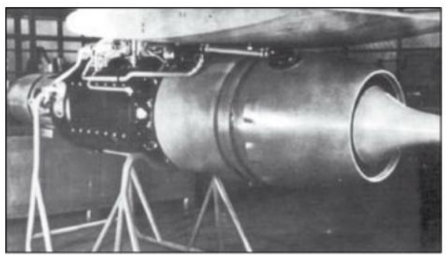
right out. The new power units did not present as many problems as the BMW power units and finally replaced them.

The basic equipment of the aircraft was thus fixed, even if the results of the subsequent flight tests called for further changes. Improvements to both engines reduced the weight by 180 kg and achieved a total thrust of 1,800 kp. In this configuration, the aircraft easily exceeded a speed of 800 km/h. The V9 test version with a smaller cockpit windscreen was even faster than 1,000 km/h on a steep descent.

However, it was abandoned due to the limited field of view.

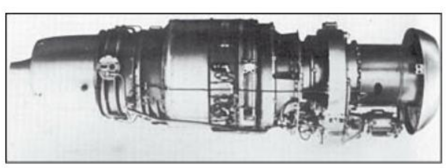
The time had come to make a decision regarding serial production

...



The BMW 003 engine on a test bench. (Photo: Military Archives)

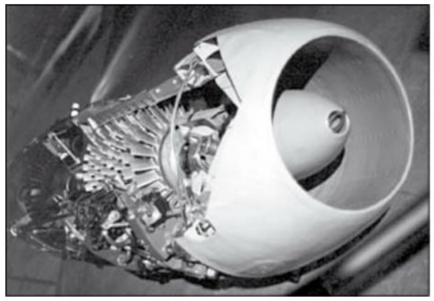
It was decided to hold an official demonstration of the aircraft, to which Hitler, Goering and other senior Luftwaffe officers were invited. November 26, 1943 was set as the date. After an impressive demonstration of the new fighter's capabilities, Hitler became its staunchest advocate and gave the order to begin preparations for series production, even though they had actually begun earlier.



The HeS-011 without housing. (Photo: NARA)

In addition to the Messerschmitt works, a number of subcontractors from various branches of industry were involved in the construction. For mounting the

Two underground complexes near Weimar and Nordhausen were identified. 26-30

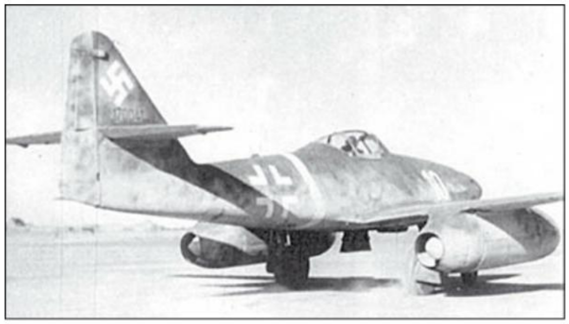


The Jumo 004 jet engine with the housing partially dismantled. This specimen was examined at Wright Field Air Force Base after the war. (Photo: I. Witkowski)

At least these were the plans for 1943. When the Me-262 was included in the so-called "fighter program" a year later, and the priorities were thus directed towards new air forces, there were already several such factories. The devastating Allied air raids of the time increased the importance of underground factories. The following underground factories were used for the production of the Me 262: "Bergkristall" near Linz (the only completed factory produced 987 aircraft, most of them within a month) was considered one of the most modern factories in the world, "Lachs" in Thuringia, 32 which could be completed to 40% and whose [31] tunnels reached a total length of 25 km, "Weingut I" as well as Bavaria, which consisted of huge semi-subterranean bunkers ("Weingut II").

[33] Under the ceiling, which is 362 m long, 97 m wide and at least five meters thick, there would even have been room for a launch catapult for the aircraft that had been built.

In addition, a number of components for the Me-262 are manufactured in other underground factories, including: [34] "Salamander" (Przyÿÿk/Poland), [35] "Mittelwerk" (1,463 engines), "Zechstein" (Rabstejn/Czech [36] Republic) and the "Flugzeugwerke Eger" (Cheb/Czech Republic). Just [34] as in the case of other types of aircraft or missiles, the Third Reich's secret weapons were closely linked to its underground economy, but I have written about this in a separate book. 37



The Me-262. (Photo: Military Archives)

Let's go back to 1943 and work on the Me-262
to return. When everything looked as if a successful weapon system had finally been developed that could have given the Third Reich, whose industry had been largely paralyzed by enemy carpet bombing, a positive turn in aerial combat, new problems arose: namely, political ones.

The Me-262A-1a/Jabo. (Photo: NAIC)

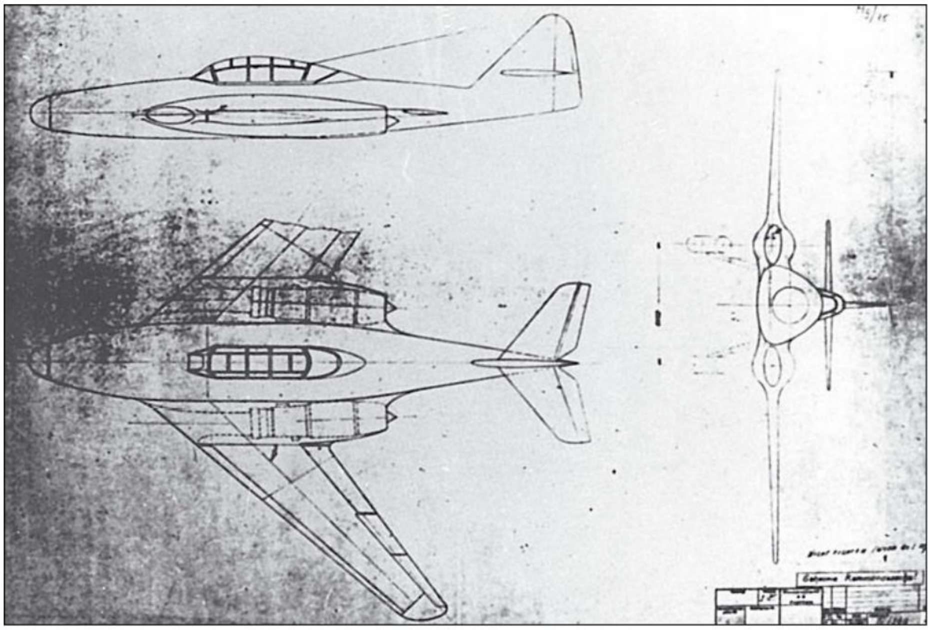
Hitler always thought only of attack and not of defence, even if this contradicted the actual situation. He now demanded that the Me-262 be "converted" into a bomber. After the invasion of Normandy, this tendency increased even more.

He believed that this bomber model was too fast and too "elusive" for the enemy and could therefore stop the enemy attacks that were penetrating deeper and deeper into France. In reality, however, the Me 262 was completely unsuitable as a bomber and the extra weight significantly reduced its performance. Although Hitler originally insisted that the Me-262 should not be called a "fighter" at all,

a compromise was reached that turned the aircraft into a fighter-bomber variant. The Me-262A-1a/Jabo was used as a basic version and had two mounts for 500 kg bombs under the fuselage.
Apart from that there were no differences to the "normal" A-1a fighter version. Independently, work was being done on a special version of the bomber that would allow bombs to be dropped in a dive.
This variant had a modified nose section that housed a small cockpit with a new bomb sight called "Lofte 7H". It received the designation Me-262-2a/U1 or Me-262-2a/U2 (later changed to Me-262A-4).

The Me-262V-1a/U1 - a two-seat night flyer equipped with radar. (Photo: Military Archives)

In the autumn of 1944, on the other hand, a completely new version was built - a night fighter. It was equipped with an on-board radar and an antenna system on the nose of the aircraft. The night fighter was developed on the basis of a two-seater training version, in which the seat behind the pilot now accommodated a radar technician and other equipment, including friend-foe detection. The fuselage was slightly lengthened to increase the capacity of the fuel tanks, which in the training version was up to 1,650 liters less than the original version. There was also the option of hanging additional fuel tanks. The Lufthansa workshops in Berlin-Staaken were commissioned to convert the training aircraft into night fighters.



Original plans of the Me-262 HG III. (photo from the author's collection)

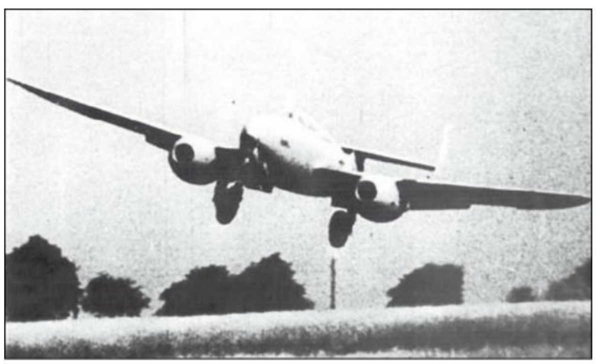
The modifications were made as follows: The B-1a/U1 and B-2 were fitted with the FuG-218 radar and an extremely useful system called the GuG-350 *Naxos* , which detects the radiation from British H2S bomber radar signals could.

Of the night fighters mentioned, only the first made it into combat. Several examples, delivered between January and April 1945, took part in the defense of Berlin and won some spectacular victories. The unit's commander, Oberleutnant Walter, shot down 29 aircraft, including two four-engined bombers. 38

The Messerschmitt 262 Schwalbe versions described above were actually built, but in addition, several very interesting and unusual versions were found on construction plans, of which there were also some prototypes in various stages of development. First and foremost, the aerodynamics have been fine-tuned. To this end, three versions were designed with new wings, which were designated HG I, HG II and HG III (HG stands for "high speed"). The HG-I version was limited to the installation of a new tail section and improved rounding of the wing leading edges (like the "high-speed" test version Me-262V), as well as a larger wing

Fuselage connection in front of the wings that reduced drag and improved lift. Completely new wings were then used in the HG II version.

Characteristic were an increased lifting surface of the wings and further improved rounding of the leading edges. The Me-262 HG III was the continuation of this development.
The roundings on the leading edges reached up to 49°, at the same time the engines were installed in the streamlined wing fuselage transitions. This was one of the many German solutions adopted by designers from other countries after the war. However, the HG versions did not make it past the drawing board versions, although minor model tests did take place. Professor Lippisch, known for his unconventional designs, suggested a modified version, with the cockpit relocated to the stern where it would be housed in a large triangular vertical fin - but this proposal was never implemented.



The Heinkel He-280 was the rival of the Me-262, but had significantly worse flight characteristics. (Photo: Federal Archives)

Among other things, research was also carried out into alternative drive options. The Me-262C3 was to be a fighter in which an additional rocket engine was provided in addition to the engines used up to then.
To do this, a container was to be placed under the fuselage, in which part of the liquid fuel rocket was located, as well as fuel tanks and the oxidizer. After reaching the desired height, the container should be dropped and, with the help of a parachute, return to the ground, where it should be collected and prepared for use again.

The Me-262 *Lorin* project represented an even more valuable design. In addition to the standard Jumo engines, it was planned to mount two large but lighter ramjet engines (a type of engine without a turbine and supercharger) above them, which would be activated once the appropriate speed had been reached. This version was probably ahead of its time. This aircraft, just like the speed at the limit of the HG-III version, was supposed to reach the speed of sound.

Finally, another drive variant should be mentioned. After the late improvements of the 'rival' BMW 003 engine, an aircraft was submitted for testing with a combined propulsion system consisting of said engine and the BMW 718 rocket engine (both housed in a single casing).

The latter was driven with a mixture of concentrated nitric acid, sulfuric acid (oxidizing agent) and an aniline solution. The burn time of about three minutes made it possible to reach a height of 7,500 meters in just 90 seconds on a steep climb! A height of 12,000 meters was reached in less than four minutes. A total of approximately 1,500 examples of all variants of the Me-262 were produced.

Finally, we should be aware that the Me-262 and the individual solutions that were used in it became the model for many post-war designs - including the Russian Su-9. German engines were also examined in detail in various countries.

Tactical and technical details of selected versions of the Me-262

	A1a	B2A	HG III
wingspan (m)	12.65	12.65	12.65
length (m)	10.60	10.75	10.60
height (m)	3.85	3.85	3.85
Wing area (m²)	21.70	21.70	28.50
empty mass (kg)	4,000	4,764	4,323
takeoff mass (kg)	6,775	7,700	6,697
Top speed (km/h)*	870	841	1,100
Range (km)	845	–	–

* in level flight at 6,000 meters altitude

The Me-163

World War II was not only the time when jet planes, but also rocket planes made their debut. The only German model used in combat was the Me-163.

The Me-163, the fastest fighter of World War II and the first aircraft used in combat without a tailplane, like the Me-262 was the result of work begun before the outbreak of World War II.

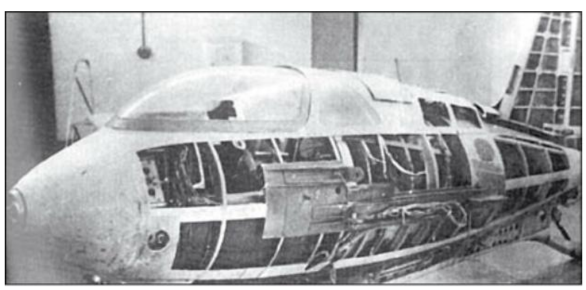
The work devoured a vast amount of resources that were disproportionate to the military benefit. 364 Komets were *delivered* to the Luftwaffe, but only about a dozen enemy planes were confirmed to have been shot down.

The Me-163 was to be an interceptor based on preliminary work by the designer Prof. Alexander Lippisch on aircraft without tailplanes, which were powered by a rocket engine. The rocket engine was designed by Helmuth Walter, a chemist from Kiel. During development, the engine was gradually improved, increasing its thrust from the original 135 kp to 1,500 kp.

The direct predecessor of the Me-163 was a test aircraft designated DFS-194 designed by Lippisch in the late 1930s. Due to problems with the drive, a piston engine was initially installed in the aircraft. In 1940, the DFS-194 completed a successful test flight powered by the Walter RI-203 rocket engine and attracted interest from the Air Ministry, which ordered the development of what would later be known as the Me-263A aircraft. It was fitted with the new and improved RI-203 engine with a thrust of 17.5 kN. In the spring of 1941, the first gliding flight was carried out, with the prototype being towed by an Me-110. In the summer, test flights were then carried out with four aircraft that were already flying with their own engines. During a test flight on October 2, H. Dittmar broke the world speed record in level flight with a flight speed of 1,004 km/h at an altitude of 3,600 meters.

The Me-163 in combat readiness. (Photo: German Museum)

Based on these results, the Air Ministry ordered a prototype Me-163B fighter, using a Walter 109-509A (R-II-211) engine with a regulated thrust of 3-15 kN, fueled with a mixture of " T-Stoff” and “C-Stoff” (hydrazine, methanol and water). To avoid spinning at high speeds, slats were installed on the wings and the shape of the fuselage was adjusted. In April 1941 the first prototype of the Me-163 BV 1 was built. A short time later, Messerschmitt AG began pre-series production of 70 Me-163 B-0 aircraft. From February 1943, Erprobungskommando 16 was tasked with training pilots and developing optimal war tactics.



A prototype Me-263 during assembly and at an airfield with incomplete fairing. Photos from the spring of 1944. (Photo: military archive)

The shockingly simplistic cockpit of the Me-163. (Photo: NARA)

The serial production fighters received the designation Me-163 B 1a. Its armament consisted of two MK-108 30mm cannons with a supply of 120 rounds of ammunition (the B-0 version had two 20mm cannons).

It is little known that units located on what is now Polish territory played a large role in training the Me-163 pilots. In Rudniki, north of Czÿstochowa, mainly glider training was conducted. The planes were already being used at the current military base in Mierzÿcice near Katowice (at that time the base was called "Udetfeld" in memory of the deceased pilot Udet). Among other things, versions of the Me-163 with multiple rocket launchers were also tested in Mierzÿcice.

Specifications of the Me-163B

empty mass:	1,905 kg
takeoff mass:	4,110 kg
Length:	5.69 m
wingspan:	9.32 m
lifting surface:	19.62 m²
Maximum thrust:	17 kN (1,700 kp)
Burn time rocket engine: approx. 8 min	
Top speed:	at sea level: 835 km/h at an altitude of 3,000 meters: 960 km/h
rate of climb:	approx. 60 m/s
rise time:	to an altitude of 2 km: 1 min 46 s to an altitude of 6 km: 2 min 26 s

	to an altitude of 12 km: 3 min 45 s
flight altitude:	12,000m
Range:	about 100 km

The He-162

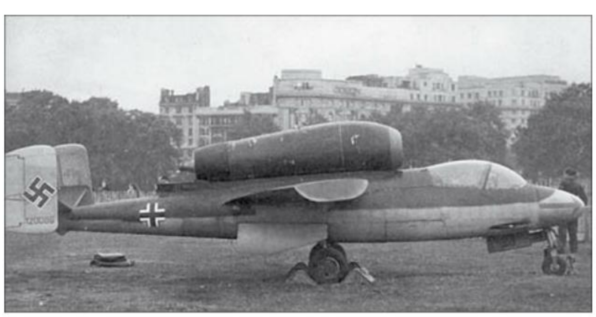
The Me-262 and Me-163 weren't the only innovative fighter jets the Luftwaffe was armed with. There was one more

...

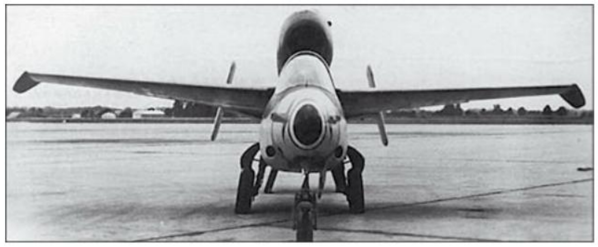
As the Luftwaffe quickly lost control of German airspace and the German armaments industry was devastated by thousands of Allied bombers, the Germans were forced to take swift and immediate countermeasures.

In March 1944, the framework for the corresponding "fighter program" was defined, the aim of which was to supply the Luftwaffe with a fighter that was relatively easy to produce and maintain and, above all, that should not consume too many strategic raw materials. The comparatively small single-seat fighter was to be produced in large numbers and powered by the single jet engines available at the time.

At the end of August 1944, the basic technical guidelines had been defined and handed over to the companies Heinkel, Arado, Blohm and Voss, Focke-Wulf and Junkers as a list of requirements. The plane should be equipped with a BMW 003 engine and reach a speed of about 750 km/h. The surface load should also not be higher than 200 kg/m². With a take-off mass of less than 2,000 kg, a take-off distance of 500 meters was aimed for. Since the "Volksjäger" was to operate from simple, densely distributed airfields, a flight time of 20 - 30 minutes was considered sufficient. The aircraft was only to be armed with two MK-108 cannons.



The He-162 at the Schwechat airfield in Vienna. (Photo: NARA)



It was in keeping with the simple structure of the fighter that the time until the designs were presented on September 20, 1944 was very tight. Series production should start on January 1 of the next year.
In practice, only Heinkel managed to keep to this tight schedule. on the 23rd On September 10, the company presented a dummy and a preliminary design of its aircraft to the Air Force Inspector General. As a result, even before prototypes and individual solutions were presented, Heinkel was rewarded with a contract for the production of the aircraft, which was signed on the same day that it received its name: He-162. The construction was technically practically risk-free - it was very simple. In order to simplify the construction of the fuselage and reduce the risk of foreign objects being sucked into the engine, it was placed on the outside - on the fuselage. This also reduced the risk of the wooden hull catching fire.

The planning work was finally completed at the end of October. Four prototypes were built. The first took off from Schwechat Airport in Vienna on December 6th. Although the flights were initially without major problems and the advantages of the astonishing mobility of this simple construction were played out, the first prototype crashed in early December 1944. Most of the other prototypes also crashed.
One of the main reasons for this was certainly sabotage by forced laborers. I have a report from a relative who was involved in assembling an aircraft tested at Schwechat. For example, he recalls that drills with a slightly larger diameter were usually used to make the holes for the bolts, which the Germans did not notice.

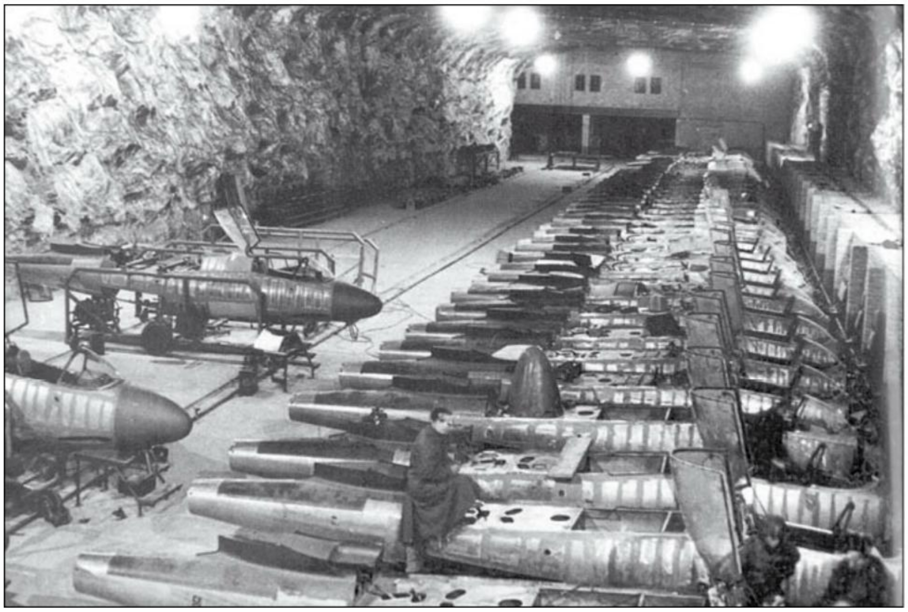
After the test flights, certain modifications were made: the wing construction was strengthened, a more powerful version of the

BMW 003 engine with a thrust of 800 kp was installed and the fuselage construction was changed. The companies were commissioned with series production.

Many of the policies and expectations surrounding the fighter were unrealistic by any measure - a fact repeatedly pointed out by Air Force officers as well as numerous industry professionals. The main criticism concerned the poor combat characteristics of the Volksjäger, which prevented it from competing with Allied aircraft, and the at least questionable usefulness of extremely poorly trained and inexperienced Hitler Youth pilots. The Luftwaffe generals instead called for an increase in production of the Me 262, which enjoyed a very good reputation as a tried and tested aircraft.
Professor Willi Messerschmitt took the same stance in his report to the Air Force Ministry: "Technically speaking, the He-162 is a step behind",

> adding that "the claims that the Volksjäger is supposed to meet are based on false foundations, as they already exist today fighter jets can perform all of these tasks better."

The years 1944 and 1945, however, were a period when rational arguments seldom met with Hitler's approval. The SS and incompetent ideologues from the inner circle gained increasing influence over the Third Reich's war machine, endorsing even the most absurd concepts in their competition for the goodwill of the Führer.



Unfinished fuselages of the He-162 in the gallery of an underground factory - probably "Tortoise"

The program for the construction of the Volksjäger was therefore continued. The unfortunate situation of the German economy, on the other hand, made itself felt more and more. Serial production was not considered until February 1945; definitely too late for the He-162 to play a decisive role. Meanwhile, there were no doubts about the implementation of the plans for series production. However, production plans from 1945 with 1,000 – 5,000 BMW 003 engines produced monthly remained mere paper tigers. In March, a critical month for He-162 production, only 100 examples were built. A total of only about 250-270 Volksjäger were produced by the end of the war. Of the few air battles in which the fighter took part, the first took place on May 2nd.

Many development versions of this fighter remained only drafts, including specimens with more powerful engines, Argus-Resojet Engines from the V1 and negatively swept wings. [26,27,29,30]

Tactical and technical details of the He-162 A2

Length:	9.05 m
wingspan:	7.20 m
takeoff mass:	2,805 kg
Top speed: approx. 840 km/h Range:	
	about 600 km

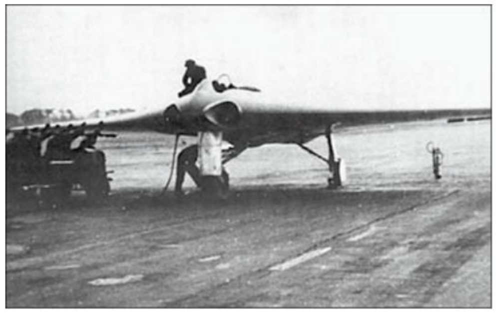
Armament:	two 20mm guns

The Ho IX

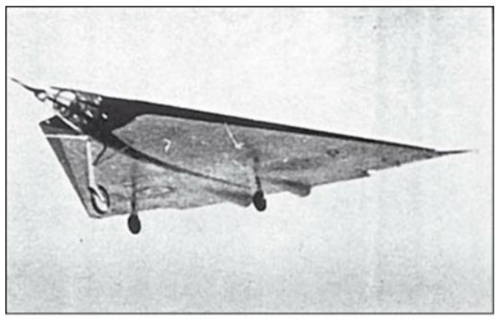
Of the many German fighter jet models, including those that did not go into mass production, one deserves special attention. This is the flying wing of the Horten brothers: the Ho-IX. This aircraft was the culmination of the fast but successful career of the young designers from Bonn.

The brothers' first design already described was the Me-163 rocket fighter and its further development, the Me-263. However, this was only one of many designs of this kind. The famous brothers Reimar and Walter Horten from Bonn were pioneers in this field not only in Germany but all over the world.

Their first self-propelled aircraft was the Ho-V, which dates back to 1936. It was an experimental design that allowed many new solutions to be tested, such as control using flaps on the wingtips, but this did not prove beneficial at the time and caused the prototype to crash. In addition to its unconventional aerodynamic system, the Ho-V was a groundbreaking design in other ways. It consisted mostly of plastic and the remaining parts of wood. With a celluloid coating on the outer skin and only a small amount of metal in the construction, the aircraft would have been very difficult to detect in a future war operation. If the radar absorbing coating (in the form of plastics and paint - see the last chapter of this book) later developed by the Germans had been used here, we would have the first "true" stealth aircraft in front of us. But the Germans didn't go that route. The Ho-V was a two-seater powered by two Hirth HM-60R piston engines with 80 hp. It was built with the financial support of Dynamit AG.

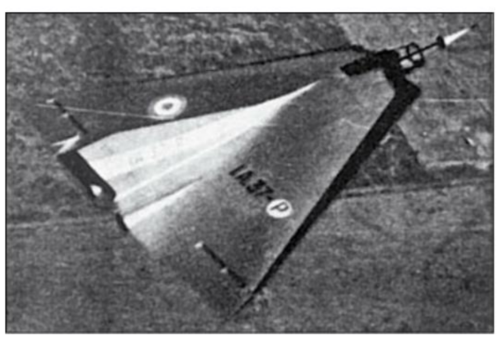


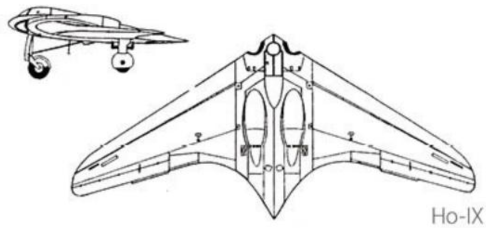
The Ho IX. (photo from the author's collection)



The Hortens aircraft completed in Argentina – the I.Ae.37. (Photo: Instituto Aerotecnica).

In the early 1940s, information reached Germany from the United States that Northrop, an extraordinarily talented designer, was working on an aerodynamic "flying wing" system. As a result, the Air Force Ministry provided the Horten brothers with unlimited funding for research projects in 1942.





The Ho-IX was a further development of the concept pursued up to then. However, the airframe was completely redesigned in view of the use of jet propulsion and anticipated military use. The construction was strengthened and a profile designed for high speeds was used. For this purpose, reference was made to the calculations and research results of Professor Busemann, who had already dealt with this problem in the late 1930s. The central part of the wing was widened and the rear edge also got a slight negative gradient, so that a relatively "thick" profile could be used in this section. This “fuselage replacement” housed both engines, the air intakes in the front section and the cockpit, relatively heavy armament (four MK-108 30 mm cannons plus ammunition) and, in the night fighter version, an additional on-board radar. The aircraft was to be powered by two Jumo 004 engines. The takeoff weight was 7.5 tons. It was sent to Gothaer Waggonfabrik for production after personal intervention by Göring, where the aircraft made a lasting impression at an air show in January 1945 (the prototype reached a speed of 800 km/h). The aircraft received the designation Ho-229. It was by far the most sophisticated design of the aircraft type discussed up to that point, but only a small group of prototypes could be built by the end of the war. As a result, the Ho-IX was never used in the war, which is a shame as it would have been very interesting to compare this aircraft to classic designs. In 1945, a combat bomber variant with a bomb load of 2,000 kg and a night fighter version were built on the basis of the version described. Both variants had two-man cockpits instead of the single-seaters in the simple fighter variants. After the end of the war, one of the Ho-229 prototypes was brought to the United States, where it was examined extremely thoroughly. The Ho-IX was probably the first

Prototype on which “radar visibility” reduction technology was tested. The insides of the wings were coated with a mixture of wood dust, charcoal and glue to absorb the radar beam and thus shield the metal framework to some degree.
However, I do not know the results of these experiments. They could have been very promising, since the very shape of the aircraft was very favorable in this respect.

At the beginning of 1945, the companies Gotha and Klemm received the first orders for series production of the Ho 229 fighter - the first for 53 and the second for 40 pieces. A night fighter equipped with the FuG-224 "Bremen" radar should be built as the second highest priority. The execution of these plans had only just begun when the end of the war interrupted them. 40-42

At the same time, namely from 1944 to 1945, the Horten brothers had also developed a number of different and interesting aircraft, all of which, however, remained in the model stage or only existed as plans and calculations.

It was about:

• the Ho-VIII intercontinental passenger aircraft, developed with the post-war era in mind, to be powered by six 3,000hp Jumo 222 aero engines mounted on the trailing edges of the wings. In retrospect, it should probably be turbo engines. The passenger cabin was to be housed in the center section of the wings, forming the fuselage of the aircraft. The take-off mass would have been 120 tons, which was quite a lot for the time. In 1945 a 1:2 scale model was built; • the Ho-X as a response to the program to build the “Volksjäger” – a single-seat fighter which, like all other designs by the Horten brothers, was obviously designed in the style of a “flying wing”. With a wingspan of 9.2 meters, it was much smaller than the Ho-IX's 16-meter wingspan and somewhat reminiscent of the Me-163 missile fighter. The Ho-X would not be ready for series production until 1946;

• the Ho XII light trainer, which was a development of the older Ho IV glider and the latest achievements of the

should combine aerodynamics, including knowledge from airframe tests with the American *Mustang.* The wingspan should be 16 meters;

- the Ho-XIII supersonic fighter, whose development began in early 1944 and which was intended to reach speeds of up to 1,800 km/h at high altitudes. The wing design of the aircraft was very interesting as it differed from all previously used designs. A particularly strong sweep of the leading edges of 60°, very thin wing sections (camber of about 10% of the wing width), a very acute angle of the leading sections as well as the exact placement of the aircraft nozzle at wing level should all contribute to the reduction of aerodynamic drag when flying at supersonic speeds . The aircraft had a fin and rudder with a strong sweep. In the first version of the fighter, a narrow cockpit was supposed to be located in the middle section of the rudder. Later it was planned to place the cockpit and the one-way undercarriage (with additional wheels on the wingtips) in a housing under the wings. Originally, the intention was to accommodate a single, large engine with an afterburner in the center section of the wings. Eventually, however, it was decided to use two "hybrid" BMW 003R engines, which would be mounted under the middle section of the wings. Such an engine consisted of a standard turbojet engine producing 1,000 kp of thrust and a liquid-propellant rocket engine producing 400 kp of thrust. At the end of the war, the first Ho XIII prototype was in the first phase of construction. In mid-1946 it should then be ready for flight tests. A wingspan of about 12.5 m was planned;

- the Ho XVIII long-range fast bomber. It was to be powered by six modernized Jumo 004H engines. It had no fuselage, instead the crew, bomb load and most of the onboard equipment were housed in the wings. The engines should be mounted under the wings. The armament was to consist of a four-ton bomb load and two anti-aircraft guns, one on the nose and the other

on the end of the tail fin. At a flight speed of 800 km/h, a range of around 8,000 km was aimed for. Part of the bomb load and the main landing gear should be able to be retracted into the wings. The Ho-XVIII should be characterized by the following characteristics: wingspan - 30 meters, lifting area - 156 m², take-off mass of the order of 34,000 kg (slightly less in a future variant with four HeS-011 engines). Work on the aircraft began in early 1945 and was to be completed two years later.

The Horten brothers were not the only Germans working on the described aerodynamic system. You had strong competition from Professor Dr. Alexander Lippisch from Munich – at that time a world-renowned scientist in the field of aerodynamics and aeronautical engineering. Lippisch's work is described in the second part of this book. It is also worth mentioning that, contrary to the generally prevailing assumption, there were many other German designs for flying wings.

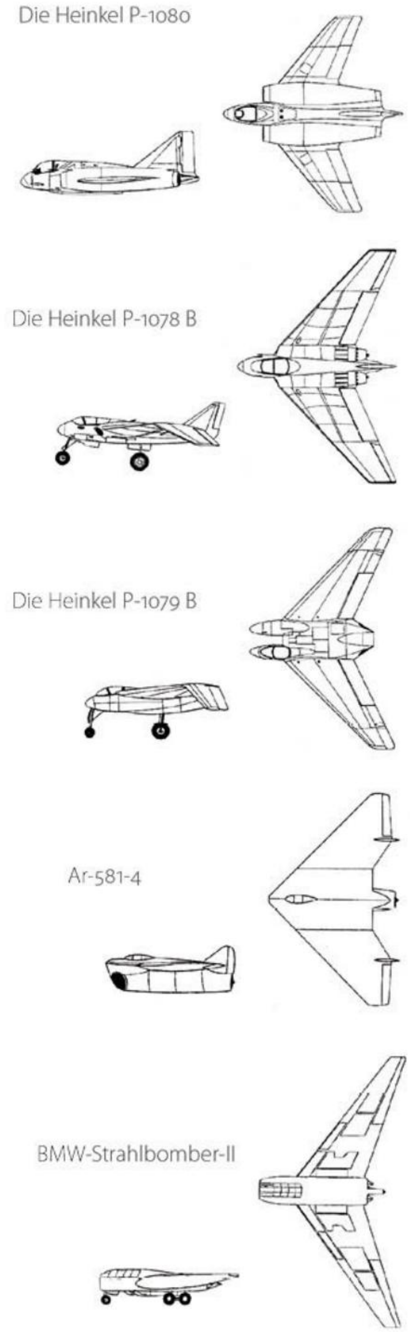
The P-1111 was one of several aircraft developed at the Messerschmitt works. It was to be powered by a single HeS-011 engine. Both the wings of the P-1111 and its fin were characterized by an exceptionally high leading edge sweep of about 45°. It is estimated that the plane could have reached a speed of 1,000 km/h in this way.

In addition to the Horten brothers and the institutes headed by Professor Lippisch, the production facilities of the Heinkel aircraft factory were the third important source of interesting constructions from the series of flying wing aircraft. The number of pieces they delivered was rather modest, but nonetheless ambitious.

Three models of these aircraft were built there in the last ten months of the war. The first was the P-1078, of which two versions existed. The first (P-1078 A) was classic and powered by one engine. Their design was similar to Kurt Tank's Ta-183 and Messerschmitt P-1101. The second version (P-1078 B), on the other hand, was characterized by a flying wing design (no tail section with a significantly reduced fuselage) and two-engine propulsion.

The P-1708 B was to be a single-seat fighter with a take-off mass of 3,900 kg and a speed of up to 1,000 km/h.
The large-area wings (about 20.5 m² with a wingspan of 9.4 m) would have allowed flying at high altitudes of about 13,500 meters.

A further development of this project was the design of the P-1079, which was available in two versions developed in parallel - classic and tailless, each identified as A and B. The second version differed from the P-1078 B in that it completely dispensed with a fuselage and fin. The pilot sat in the cockpit, which was housed in the front left part of the wing center section, a similarly shaped housing on the right side was intended for the onboard radar and guns. This version was designed as a single-seat night fighter.



The concept of the P-1080, on the other hand, represented a somewhat different development path. From its general construction it differed less from the P-1078 than from the P-1078 B, but two new ones, designed by Dr. Sänger developed ramjet engines with a large diameter (90 cm) for use. However, these should be powered by conventional fuel. After the aircraft had been accelerated by four solid propellant rocket engines, the main engines were to

be ignited to achieve a thrust of 1,170 kg at a speed of 500 km/h and 4,370 kg at a speed of 1,000 km/h. A serious problem that could never be solved before the end of the war was the extremely high temperature in the combustion chamber, which reached 2,500 °C. The P-1080 was designed as a fighter and equipped with an onboard radar hidden under the nose window. Not even a single prototype was completed before the end of the war.

The Arado company also tried to construct its own aircraft without a tail unit (this time as a fighter variant), which received the designation Ar-581-4. It was to be powered by only one HeS-011 engine.
This model was to have triangular wings with a wingspan of about 10 m, resembling an isosceles right-angled triangle in outline.

BMW's concept, known as the *Jet Bomber II ,* was similar in design to the Junkers EF-130. It was to be an aircraft with a take-off mass of 31,500 kg, powered by two BMW 018 jet engines placed in the aft center section, each with a thrust of 3,450 kp.
A combat load of well over 10 tons, which was very large for the time, was planned. It was one of several bombers considered as part of a program to design a new, fast, long-range bomber. At the end of the description of jet fighters in the Third Reich, the work on their second generation - based on the Me-262 - should be mentioned. It is about Lippisch's P-13b aircraft, the Ta-283, the *engine wings* (described in the second part of the book), as well as Messerschmitt's P-1101 and P-1110 and Kurt Tank's Ta-183. Of the last three, only the P-1101 and Ta-183 probably reached the prototype stage.

Messerschmitt P-1101

The P-1101 was developed from July 1944 until the end of the war based on an order placed by the Air Force Ministry in mid-1944. Based on the test results of this design, a new, tactical fighter aircraft was to be created (after any necessary modifications) that could have supplemented the Me-262. It should be better for

Be suitable for conducting dogfights with enemy fighters, be distinguished by greater maneuverability and - what was extremely important - achieve a speed of not less than 1,000 km/h in level flight. However, the construction was significantly simpler compared to the Me-262. The aircraft was also less demanding in terms of the increasingly scarce raw materials.

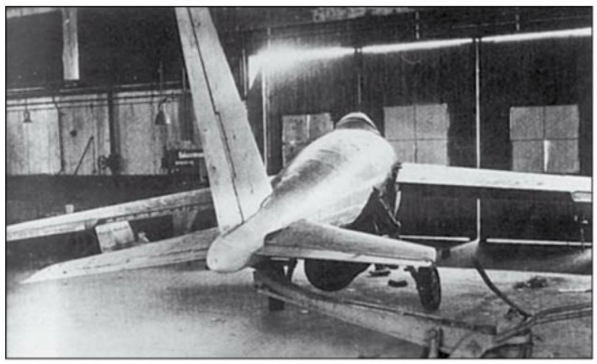
The P-1101 with the engine and dummy guns installed (probably only after the war), but without the engine nacelles, wing-to-fuselage transitions and rear fuselage section. (Photo: US Army)

It was intended to be powered by a single HeS-011 jet engine, but due to production constraints the BMW-003 engine was temporarily used. The engine was located in the lower center section of the fuselage, with the air intake placed in the nose cone. Above the engine and behind the cockpit was the fuel tank, which was sufficient for a flight of about half an hour. Additional fuel tanks were housed in the wings.

The most important key to the success of the P-1101 should be the use of the latest achievements in aerodynamics, including in particular the strong wing and control surface sweep. One of the prototypes constructed during the early months of 1945 had the wings installed on "adjustable" mounts, allowing the wing sweep to be varied between 35° and 45°. However, this could

only happen on the ground.

By the end of the war, the first prototype of this aircraft was 80 percent complete (only the engine had not yet been assembled). After its takeover by the Americans, it was taken to Bell Laboratories - similar to the case of the Ta-183, the surrender of Germany did not mean the end of the project. However, in the Americans, the wings were mounted on bearings, which allowed changing the geometry during flight.



The P-1101 - rear and front view. (Photo: US Army)

After its completion it received the designation Bell X-5. During the flight tests it turned out that a large part of Messerschmidt's plans could be realized. However, certain deficiencies persisted. The first was the relatively strong flight instability that resulted from the "offset" position of the engine axis to the center of thrust.

It was also very difficult to guide the aircraft out of a spin, which led to an accident with serious consequences. After that the program was terminated.

Another problem was the short maximum flight time. In Germany, attempts were made to remedy this by designing a development version (P-1106) in which the cockpit was moved significantly to the rear. In the front part of the fuselage, sufficient space was gained for an additional fuel tank, which could have extended the flight time to around an hour.

Despite certain shortcomings, the P-1101 remains one of the groundbreaking designs of the Second World War. 29:43

Tactical and technical details of the P-1101

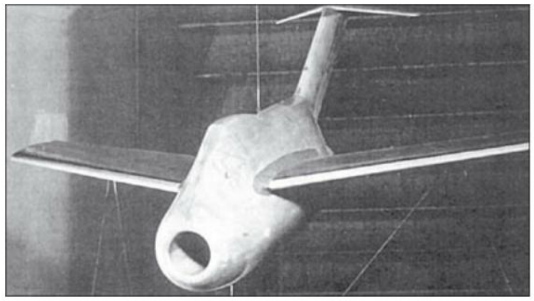
Length: 9.17 m Wing span: ap	prox. 8
m (adjustable)	
Takeoff weight: 4,070 kg Maxi	mum speed:
approx. 980 km/h Flight range:	approx. 500 km
Armament:	
	four 30 mm guns

Focke-Wulf Ta-183

In the Focke-Wulf factories, under the direction of Kurt Tank, the company's main designer, a very interesting design was created that competed with the Messerschmitt P-1101. It was the Ta 183, one of many Third Reich-era designs that would play an important role in the development of jet aviation immediately after the war. 27:43-45 Their plans, which fell into the hands of the Russians in 1945, were used, among other things, for the design of the MiG-15. The Ta-183 was a significant step forward not only for the development of aeronautical engineering, but also for technology in general, since the Germans, as in many other cases, were forced by savings and the need to simplify technical procedures. The labor required to build this aircraft was even estimated at 25 percent less than for the Me-262.

Work began in early 1942 when the Air Force Ministry expressed interest in Tank's concept for a single-engine jet fighter, although by then the general design and aerodynamic specifications had not been finalized. The engine had not yet been selected either

been, although initially the Jumo 004 engine was favored because it was technically the most mature at that time.



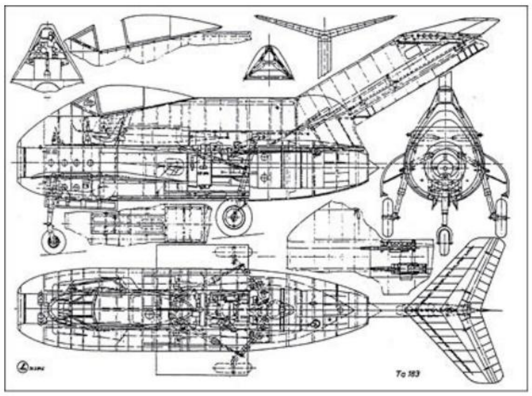
Dummy Ta-183 in the wind tunnel (Photo: DVL)

The design office, headed by engineer Mittelhuber, received the order and began designing many different versions of the aircraft. Since a completely new construction was to be created here, earlier experience could only be used to a limited extent; there was also a lack of developed and tested theoretical foundations. Ultimately, this led to a total of nine different versions of the Ta-182 being designed before the final configuration was chosen.

A groundbreaking feature was the very strong sweep of both the wings and the control surfaces. The hull of this last variant was short, while the control surfaces were lengthened by their strong sweep, now reminiscent of the sloping outline of the letter "T". Exactly this type of construction was later introduced both in the west and in the east - among them with the MiG-15. Only sloping aerodynamic surfaces made it possible to take full advantage of jet propulsion. After introducing certain modifications, especially on the control surfaces, and moving the cockpit further back, the final configuration of the Ta-183 fighter was born. Powered by a HeS-011 engine, it should reach a speed of about 1,000 km/h. The wing had a sweep angle of 32° and the aircraft was to be armed with two MK-108 30mm cannons. The construction of the prototypes began in January 1945, for technical reasons with the Jumo 004 engines. It was not possible to complete them before the end of the war. On February 23, 1945, a contract for the series production of the Ta-183 was even signed in Bad Eilsen, which of course never came into practice

was implemented.

However, work continued after the war ended...in Argentina, where Professor Tank, his engineering team, and documentation were relocated in 1947. Based on the results of work on the Ta 183, the *Pulqui-I* and *Pulqui-II* models were built there, the flight of which was demonstrated during a military parade in 1952. Although this aircraft was considered one of the best jet fighter models at the time, it never went into mass production. Work on the Horten brothers' flying wings also continued in Argentina.



Original plans of the Ta-183 V1.

It was certain events in Buenos Aires that led to the development of Kurt Tank's design. Its main protagonist was Gallardo Valdez, a major in Argentina's military intelligence service and a former research associate at the Caltech Institute in California. Shortly before Christmas 1947, he was preparing for a research trip to Moscow, but this was soon called into question when he received orders via the "military channel" to take over the position of air attaché in Stockholm. Before the contradictory instructions could be clarified, he had to cancel all plans.

In late autumn of the same year (i.e. spring in Argentina), a branch of the intelligence service in Madrid received the report that a group of excellent German scientists and designers was in Norway and was to be smuggled into Argentina immediately. The group used fake, am

Papers issued at the end of the war and could be unmasked at any time.

Major Valdez was personally entrusted with the mission of their transfer. In the last days of 1947 he went to Sweden - not to take up his new position, but to await more detailed information about a meeting with the Germans.

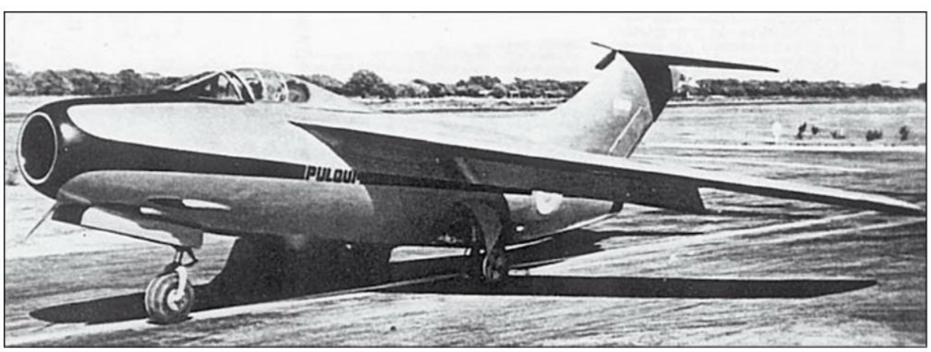
After that he was supposed to travel to Oslo. Since the meeting had been arranged beforehand by Muret, the Argentine consul in Norway, everything happened very quickly. In order not to give the enemy time to react, the Germans, together with Valdez, went to the airfield immediately after the meeting, where a plane was already waiting for them.

It embarked on a 40-hour flight to Buenos Aires (nearly 13,000 km), broken up by brief stopovers for refueling. With the exception of a few meaningless utterances in English, the Major hardly spoke to the Germans at all during this time. He could only remember that a name like "Matias" or "Matthies" was mentioned. This was actually Pedro Matthies – the alias of Kurt Tank, one of the most prominent aviation designers of the 20th century. He had with him two of his most important employees and a suitcase full of microfilms of technical drawings. More of the professor's staff were originally supposed to be on board, but some had been arrested in Denmark and the plane had to take off without them. However, thanks to the help of the Argentines, Tank was able to quickly select new employees and thus "reconstructed" his research team. The aviation operations near Córdoba were made available to him. There he was to finish work on his very promising project – the Ta-183. 1948 also saw the no less prominent Reimar Horten, the co-designer (together with his brother Walter) of the famous German "flying wings", including the super-modern jet fighter Ho-IX/ Ho 229, which in 1945 reached a speed of over 800 km/h .

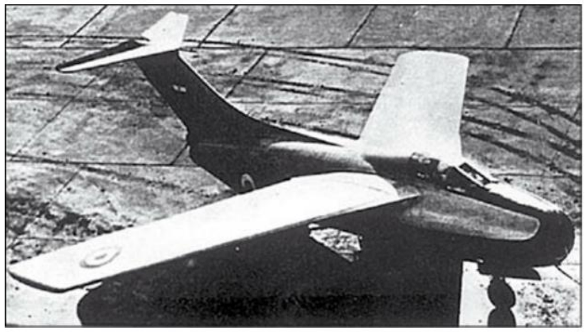
Another prominent aeronautical designer of the Henschel concern appeared in the facilities of Cordoba - Julius Henrici. There were also specialists from other well-known companies such as Fieseler, Messerschmitt and Focke-Achgelis. The latter pioneered the manufacture of helicopters.

The arrival of Tanks was a significant event even for Perón, the tank

soon presented a memorandum describing the technical possibilities of his country, together with general guidelines for aviation development. In return, Tank proposed designing four types of aircraft - a light trainer, a reconnaissance aircraft, a medium bomber (these three types would be propeller-driven), and a modern jet-powered fighter. The latter type of aircraft aroused the greatest interest of the Argentine President and secured his immediate goodwill. The basis was to be the construction of the Ta-183, on which Focke-Wulf's project department in Bad Eilsen had been working during the final weeks of the war. In this case it was the version with a high tail (in the shape of the letter "T"), which the well-known aerodynamicist Hans Multhopp had worked on. This project had been advanced to the wind tunnel model testing stage in Germany, but unlike the Messerschmitt P-1101, a full-scale prototype was never built. A twin-fuselage competitor version (similar to the British *Vampire fighter)* never got past this stage. However, it was precisely their authors - Ludwig Mittelhuber and the engineer Ulrich Stampa - who were to support Tank in Córdoba in his work. Paradoxically, Multhopp was later hired by the British and continued to develop their project.



The *Pulqui-II* - a post-war development of the Ta-183. (Photo: Instituto Aerotecnico)



However, the Argentinean I.Ae.33 *Pulqui-II* fighter was not intended to be just a finished Ta-183. Significant changes were introduced, thanks to which it was characterized by better flight performance than the model designed in Bad Eilsen. In addition, completely different components had to be used. The Ta-183 was originally intended to be powered by an engine that no longer existed - the Heinkel HeS-011, which had not been completed by the end of the war and which, according to very optimistic estimates, could develop a speed of almost 1,000 km/h in level flight should. In Argentina, on the other hand, a Rolls-Royce Nene-2 engine was used, which was characterized by similar dimensions and was considered very modern at the time (despite the unpromising use of a centrifugal compressor). This version was very similar to the model that the Russians copied and then used to power their MiG-15s. Along with the American F-86 *Sabre*, it was one of two counterparts of the *Pulqui-II.* Incidentally, this comparison alone gives a very high rating to Kurt Tank's team, who had largely worked out his project during the war, so from the technical point of view in a completely different epoch and using much simpler means than those later used by the design offices were available in the USSR and the USA. The British, who interrogated him shortly after the war but strangely enough did not try to persuade him to cooperate, also judged Tank in a similar way. This was also expressed by Tom Bower, one of the best experts on the Allies' "hunt" for German scientists: 48

“Tank and his aerospace design team were proud of theirs achievements and upset that the British, without further ado, simply sent him back to Germany instead of him straight away

to be rewarded for his talent with a permanent position. Handel Davis [British aeronautical designer – ed. authors] - one of many who chatted with Tank for hours was not at all surprised that Tank was not hired by the British: 'He was such an important person, so great that it would have been incredibly difficult to put him in a accommodate the construction team. He probably wouldn't have been able to submit.'"

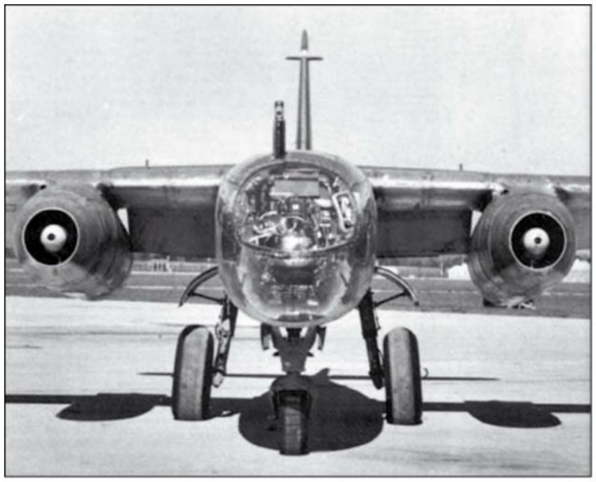
In addition, it should not go unmentioned that the "Argentine continuation" also took place because many well-known pilots - flying aces of the Luftwaffe - arrived in Argentina, including Hans Ulrich Rudel, General der Jagdpilot Adolf Galland or General der Kampfpilot Werner Baumbach, who died in Argentina died while testing a development version of the Hs-293 guided missile.

jet bomber

A number of jet bomber designs were also developed during the Third Reich, although only one type was accepted into the arsenal (apart from the Me-262 bomber version).
It was the Arado Ar-234 *Blitz.* 26,27,29,39

The Ar-234, like the Me-262 and the Me-163, is already described at the beginning of this book, contrary to an alphabetical or chronological order, since these machines are among the only far advanced German aircraft designs that it was still possible to use in still be used in combat to a significant extent.

The Ar-234 was originally designed as a fast, medium-range reconnaissance aircraft, but over time bomber missions became its primary purpose. It was the first jet bomber to see action.
Between the summer of 1944 and April 1945, just over 200 were made in a few versions.



The Ar-234B. (Photo: NAIC)

Work on this aircraft began around the turn of the year 1940/1941. It was to be powered by two engines, which the reader already knows from the description of the Me-262: BMW-003 or Jumo-004 (depending on the version). Eventually, however, the decision was made to mount four engines (a pair in a common engine nacelle under each wing), as the BMW engines were characterized by less thrust, but on the other hand they were also lighter

were.

A prototype powered by four BMW 003 engines. (Photo: Military Archives)

This is how the later versions B (2 x Jumo) and C (4 x BMW) came about, which could fly up to 20% faster with the same range.
In the C5 version, it could even be increased to over 1,000 km. The main differences between these aircraft resulted from the different number of different engines. With the Heinkel Hirth HeS-011 engines, a concept by Hans Joachim Pabst from

Ohain, a P version was also designed, which was interesting in terms of construction, but technically not fully thought through. Only 28 aircraft with these engines were built due to ongoing problems with the elimination of various deficiencies. Consideration was also given to using two Daimler-Benz twin jet engines (with final designation DB-007), but work could not be completed in time. They were probably the most modern jet engines ever designed in the Third Reich. An addition to the propulsion components described above were additional rocket engines, which assisted aircraft with Jumo-004 engines during take-off.

The Ar-234 after the war. (Photo: US Army)

The typical combat load of an Arado-234 consisted of two bombs suspended under the fuselage weighing 500 kg or a single bomb weighing one ton.

Until the end of the war, the possibilities of transporting guided missiles with this aircraft were investigated, including the *Fritz* X steerable explosive bomb, the Hs-293 air-to-surface missile and the V1 missile.

Firearms (for defense) were modest. They consisted of two mounted MG-151/20 20mm cannons. This was simply because the best means of defense against enemy fighters was the high flight speed of the jet bomber, which was several hundred kilometers per hour faster than the enemy propeller-driven aircraft.

If the *Blitz* encountered hunters during a combat mission, it was usually able to flee safely. With two Rb 50/30 and Rb 75/30 air cameras installed in the fuselage, reconnaissance tasks could be performed.

Tactical and technical details

	Ar-234B2	Ar-234C5	Ar-234P3
length (m)	12.16	12.90	13.30
wingspan (m)	14.41	14.41	14.41
height (m)	4.28)	4.28	4.28
Lifting area of the wings (m^2 Empty	27.0	27.0	27.0
mass (kg)	4,900	6,570	5,995
Takeoff weight (kg)	about 10,000	11,150	10,675
Maximum speed at 6,000			
m altitude (km/h)	735	870	820
Flight range (km)	770	1,020	–

The Allied carpet bombing, which had intensified since the beginning of 1944 in particular, led to a far-reaching reassessment of the concept of air warfare. Due to the small number of night fighters, combating British bomber formations that conducted their combat operations at night presented a particular problem. Much of this was due to Hitler's ignorance, as he was reluctant to use the Me-262 as a fighter and work on the He- 219 Uhu night interceptor delayed. Only in October 1944 (when it was already too late) did the conversion of the Me-262 training and combat fighters to night fighters begin.

The same requirements were also placed on the Ar-234. However, since this aircraft was designed as a single-seater, additional space had to be created for a second crew member, namely the radar technician. This was made possible by removing the cameras mounted just behind the cockpit. However, the Ar-234 was not particularly well suited to the new role, mainly due to the lack of cockpit armor. In the end, a completely new version with an armored cockpit (the P version mentioned) and seats for three crew members was designed. However, the decision for this final configuration was not made until February 1945, which is why it did not go into series production.

Many alternatives to the Ar-234 emerged, of which there were two to

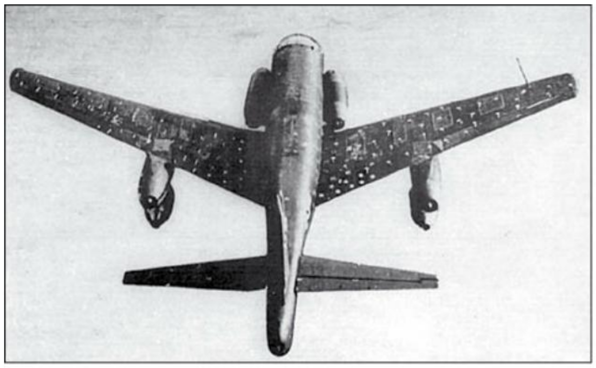
Prototypes and corresponding test flights managed. These are the Heinkel He-343 - an aircraft very similar to the Ar-234 - and a completely different and unconventional design: the Junkers Ju-287. This was much heavier and had a much greater combat load than the Arado. 27,29,30 However, this aircraft never went into series production, only a few prototypes were built until the end of the war (ie until 1944). This was because it was developed later than the Ar-234, namely only since early 1943.

In order to speed up the design work, many elements and assemblies were used that had already passed their practical test in other aircraft - including the modified (and later further converted) fuselage from the Heinkel He-177 *Greif heavy bomber,* control surfaces from the Junkers Ju-388, the main landing gear from the Junkers Ju 352 and the front landing gear from a captured American B-24.

The Ju-287 was the heaviest jet bomber of the Third Reich. (Photo: Federal Archives)

The first prototype was powered by four Heinkel-Hirth HeS-011 jet engines with a thrust of 12.75 kN (1,300 kp); However, since these were still not mature, six BMW 003 A-1 engines with lower thrust were used for the other prototypes. All these solutions had already been tested, but the aerodynamic system was used for the first time and made the Junkers-287 a real novelty: namely, the aircraft was equipped with negatively swept wings. You should check the flight characteristics of the machine

improve, mainly by maintaining good controllability both at a critical speed of up to Mach 0.85 and at lower flight speeds. On the other hand, there were problems with the wing stiffness; However, during the flight tests with the prototype, the innovative aerodynamic concept was able to clearly demonstrate its advantages.



The Ju-287 in flight. (Photo: Federal Archives)

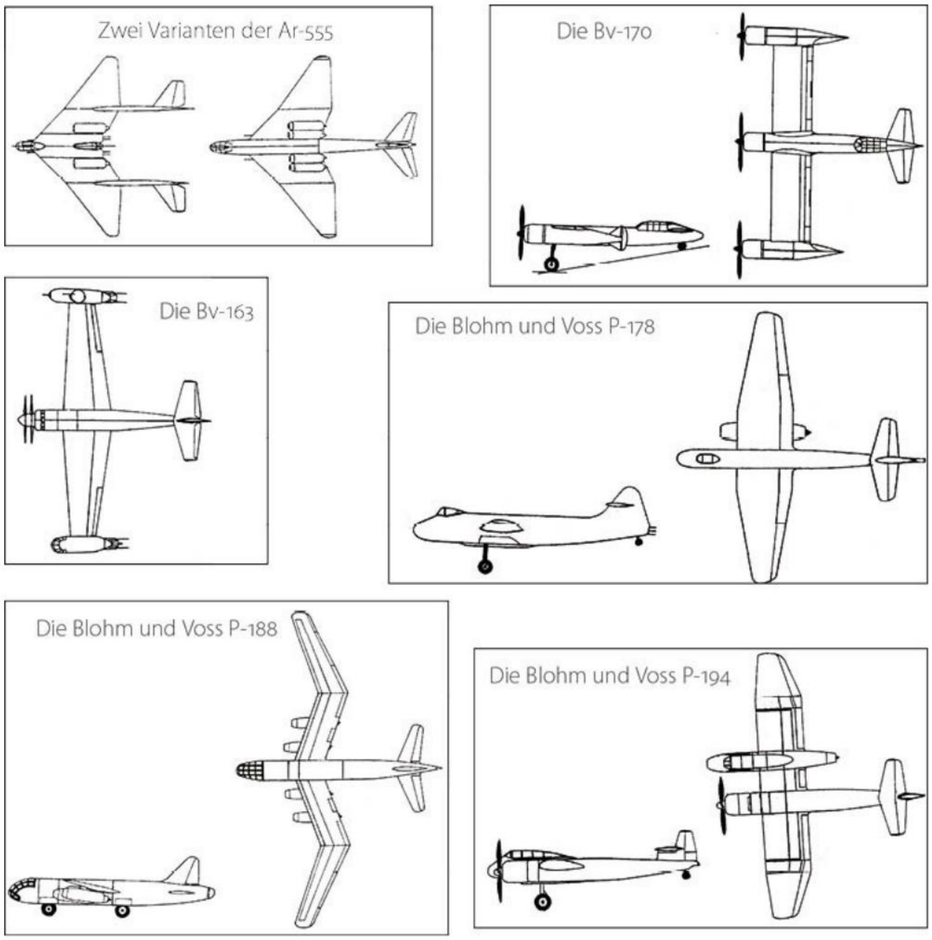
As a bomber capable of speeds of 400 mph (650 km/h) in level flight, the Ju-287 would have been particularly dangerous to the Allies. With a combat load of two to four tons, they would have z. B. can effectively attack targets located in Great Britain and thus represent an alternative to the V1 and V2 rockets.

Tactical and technical details (V-1 prototype)

Length:	18.28 m
wingspan:	20.10 m
empty mass:	12,510 kg
Take-off weight: 20,000 kg Top Speed:	650 km/h
Combat load: 2 – 4 tons Flight range:	
	up to approx. 4,500 km

A very important inspiration for the development of innovative aircraft designs - not only for bombers - was of course the introduction of jet propulsion. Although in the beginning only the engine itself was new and traditional aerodynamic concepts were used, a second generation of jet aircraft soon emerged that was able to fully exploit the advantages of the new type of engine.

It is worth examining some of these unfinished projects, if only as a contrast to the aircraft technology of just before
outbreak of war.[27.43]



An example of this generation would be For example, designs for Arado jet bombers that would replace the Ar-234 in the future.

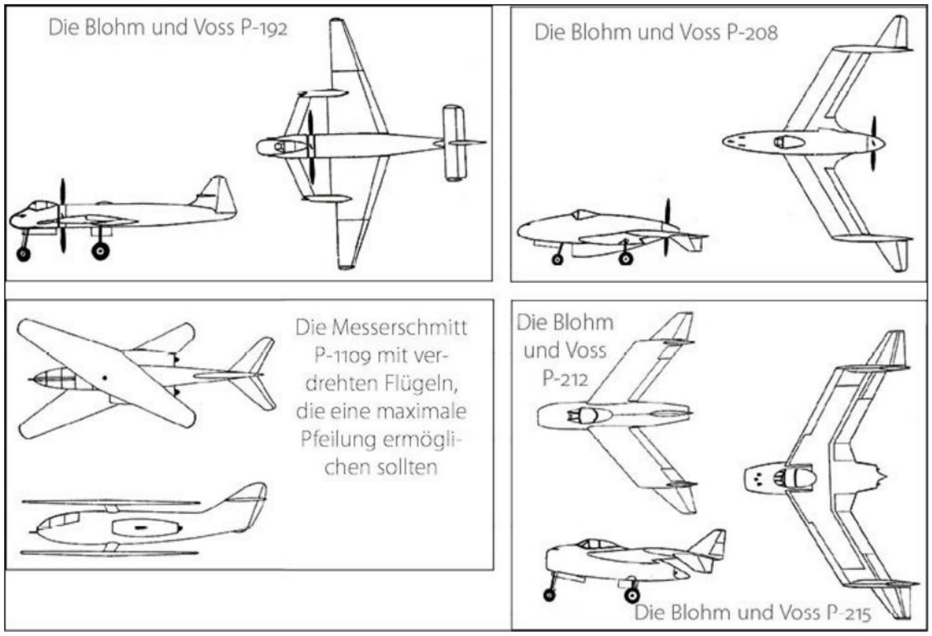
First came the E.560. The main difference from the Ar-234 was the use of new delta wings with a leading edge sweep of about 20°.
In early 1945 a model of this aircraft was tested in the wind tunnel.

In addition, at least three more advanced projects emerged: the Ar-555 (two projects) and the Arado II, which was another modification of the E.560, increasing the wing sweep even further. A tail unit with a similarly pronounced sweep was also used. The fuselage construction was redesigned and more streamlined. In the nose cone should be four MK-108 30mm

Cannons are housed, which would have made it possible to use it as a fighter pilot. The propulsion unit was limited to two HeS-011 engines.

The next stage of development was the Ar-555 project, of which there were two fundamental modifications. Common features included a wing with kinked leading and trailing edge sweeps—the sweep was larger on the fuselage and smaller on the outer section. Two to four jet engines of an undetermined type were planned, which were to be hung under the wings in the immediate vicinity of the fuselage. The first version was characterized by a hull and control surfaces similar to the Arado II; however, their further development was based on a completely different conception. The actual fuselage was abolished and only the middle section of the wings was enlarged. In its front part there was a small cockpit for the pilot, in the middle a bomb chamber, and at the back - on the trailing edge of the wing - the cockpit of the gunner, who could also perform the duties of bombardier. The remainder of the rear fuselage section, including the control surfaces, was "split" into two narrow transoms that were connected to the central area of the wings. The advantage of this concept was that the gunnery “responsible” for protecting the rear part of the aircraft was moved to the central area of the aircraft, which significantly reduced the mass of the rear (“split”) fuselage part.

In the field of innovative bomber designs, one concept that Daimler-Benz tried to realize in 1944 must also be mentioned. 21,27,43 The aim was to solve the problem of transporting weapons of mass destruction (including chemical weapons) to distant destinations such as B. America to solve.



In 1944, Daimler-Benz AG began to work in this area. She focused her efforts on design plans for huge strategic aircraft - carriers of jet bombers, or radio-guided or kamikaze-piloted planes - flying bombs, built on a similar principle to the Mistel Project.

This resulted in projects for two carrier aircraft:

The Fa-233 was one of the many helicopters built during the Third Reich. (Photo: Military Archives)

The FL-282 helicopter. (Photo: US Army)

Project "A" was based on an aircraft to be powered by six HeS-021 jet engines, each capable of producing 3,300 kp of thrust, mounted in nacelles above the wings. The chassis design was solved in an interesting way, considering that the bomber was supposed to be transported under the fuselage. The landing gear consisted of just two legs - tall pylons placed under the middle section of the wings. It's entirely possible that there were plans to house fuel tanks inside. In their lower sections, three wheels arranged in rows were to be accommodated in long fairings.

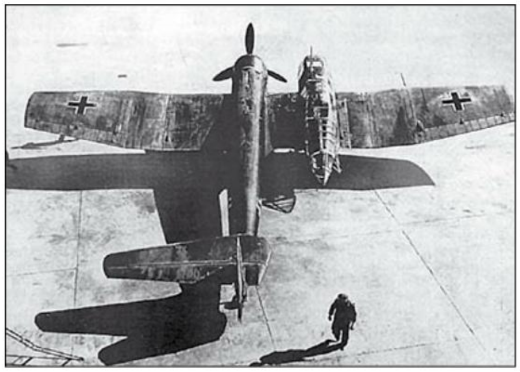
An innovative design meant a great risk, although superior designs sometimes emerged in this way. An example of this is the Dornier Do-335 *Pfeil* with two propellers – at the nose and at the stern. (photo from the author's collection)

For understandable reasons, according to Project “A”, the flight range of the launcher could not be precisely predicted, but it should allow attacking targets in the eastern United States. He was unarmed, since the bomber's detachment was still above the comparatively safe

Atlantic Ocean should be done.

The bomber itself should be of simple and relatively classic construction, apart from the "V" shaped control surfaces - and the lack of landing gear. The latter resulted from the specific design of this system. The carrier's task was simply to "deliver" the bomber to the limits of the carrier's range, undock it and return to base as quickly as possible. After switching on its engines, the bomber should reach near the speed of sound in the descent to the target in the coastal area, which should make it possible to dispense with defensive armament. After dropping the bomb(s), he should do a "stomach landing". After that, the crew was to be evacuated by submarine. The expected carrying capacity of the bomber is unknown, but it is clear that it was planned to be powered by two BMW 018 jet engines with a thrust of 3450 kp.

The Blohm and Voss company, pioneers in introducing unusual types of aircraft, manufactured, among other things, a small series of asymmetric BV-141 aircraft.

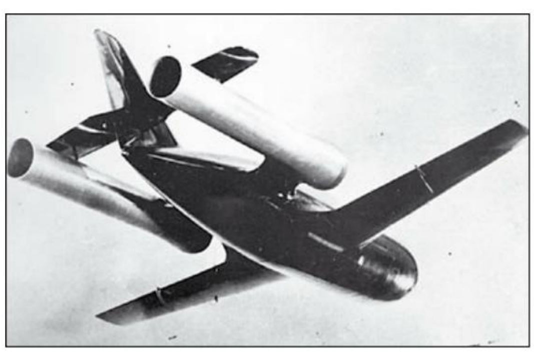


There was a tremendous amount of waste behind this concept - the combat potential envisaged was disproportionate to the complexity and cost of the whole system. The situation would be different in the case of transporting a nuclear bomb, but in 1944 this remained only a theory.

Project "B" was a certain modification of the above conception: it was planned to have a carrier with slightly redesigned wings and a more economical piston engine: six DB-603 engines with a power of 1,750 hp each, four propellers placed under the wings and two pusher propellers drives. As in the "A" variant, this carrier was intended to transport bombers or up to six smaller kamikaze aircraft or machines remotely controlled from on board the carrier.

Both projects were presented to the Luftwaffe command in 1944, however, not accepted for implementation.

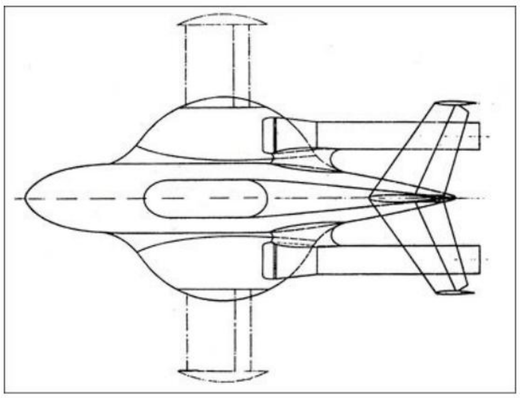
A modern and equally unconventional jet-powered bomber was also being worked on at the Blohm and Voss works, which had hitherto made a name for themselves with the production of seaplanes. 27.43



The end of the war was marked by simple and cheap aircraft projects. In the picture:

a model of the Me-328 in the wind tunnel. It was to be powered by two deflagration jet engines. (Photo: DVL)

The Me-328 (a non-engined example) on its first flight. (Photo: DVL)



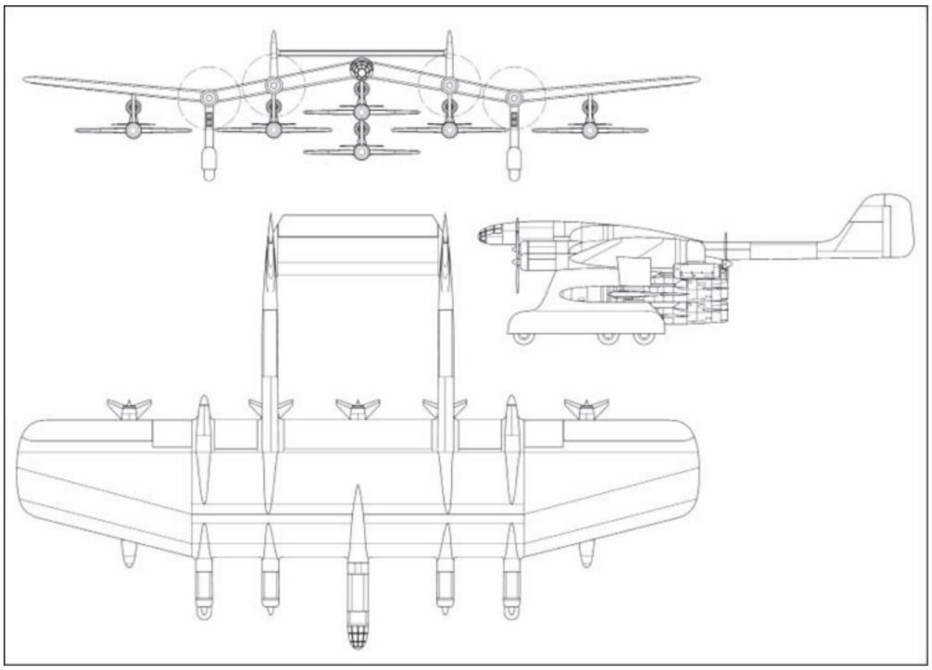
Original drawing of one of the planned further developments of the Me-328.

The P-188 is an example of a bomber that was intended as a counterpart to the Ar-234 but never went into mass production. There were two versions: the first, powered by four separately hung jet engines (P 188.01), and the P-188.04, in which the engines were placed in pairs in two nacelles. The characteristic features of this bomber were positively swept wings in the middle area with simultaneous negative swept in the outer sections. It also had an atypical landing gear - both main legs were in the extended position just below the fuselage axis; two additional legs with smaller wheels, which were extended from the outer sections of the wings, should serve to stabilize the plane horizontally. It was planned to use four Jumo-004-C engines, which were already known from the Me-262 and Ar-234. Apart from the bomb load carried in the bomb bay, four 20 mm guns fixed in the fuselage were

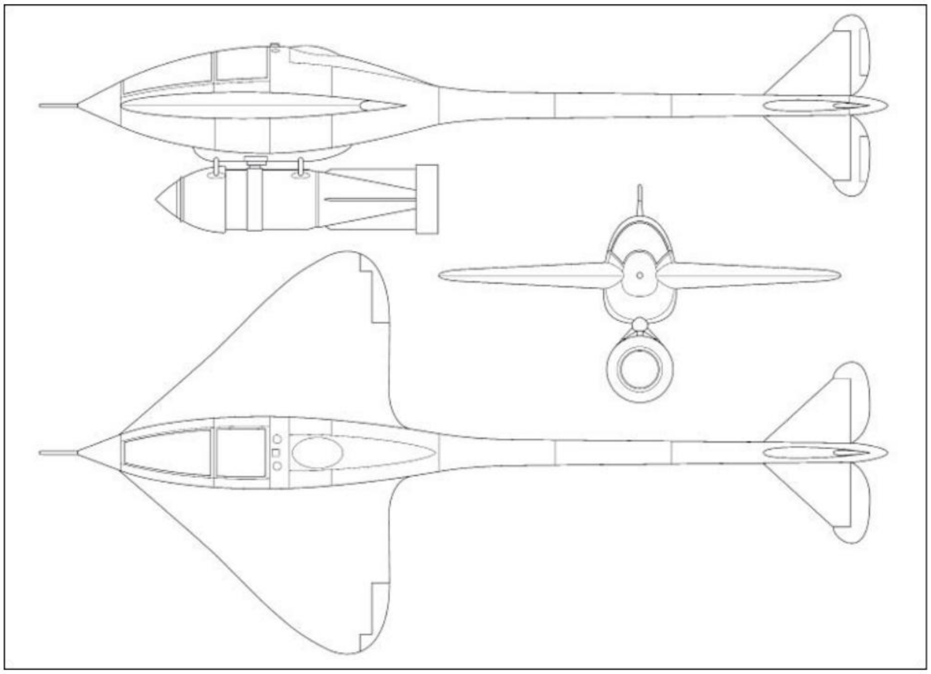
Cannons and two to four 13 mm machine guns in one or two machine gun turrets, which should be located in the rear part of the fuselage.

Tactical and technical details of the P-188.01

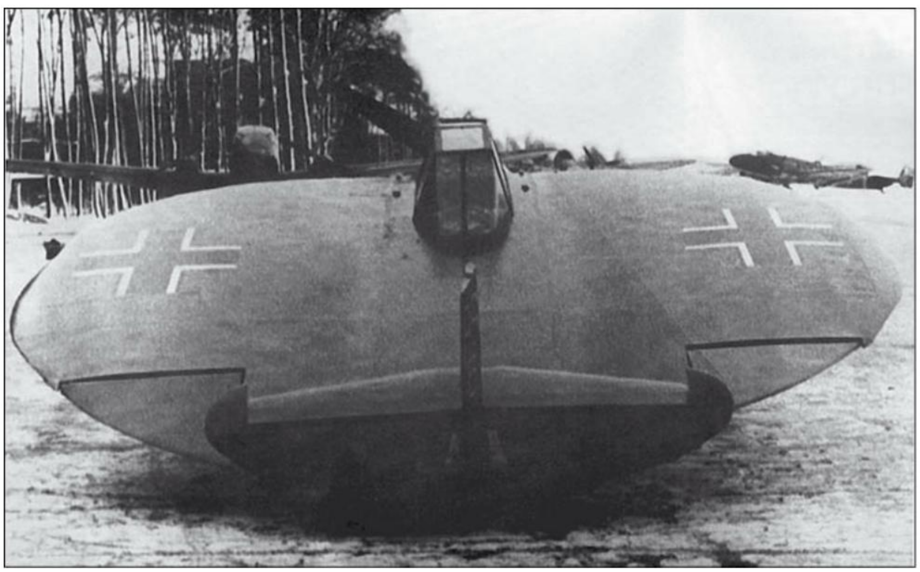
Length:	17.5m
Wingspan: Take-	27m
off weight: 23,800 kg Maximum	
speed: approx. 820 km/h Flight	
range: up to 1,500 km	



The Daimler-Benz projects "F" and "C". (Drawing: M. Ryÿ)



glider bomber / glider-bomber (drawing: M. Ryÿ)



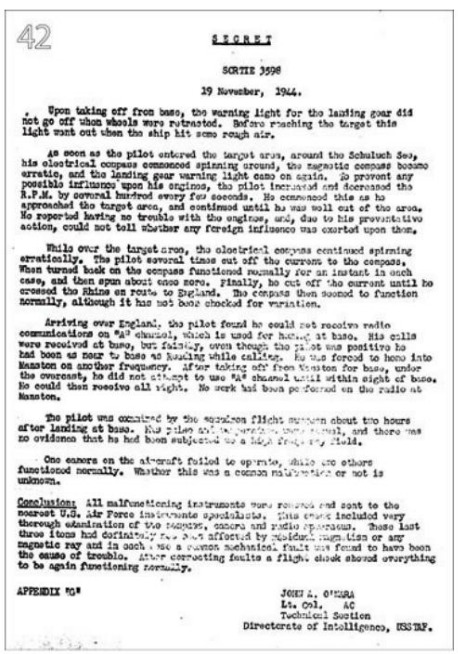
In Germany, there were also some projects with round wings. The picture shows the AS-1, built in Leipzig before the war.

Electromagnetic weapons and alternative solutions

Despite appearances, the title of this chapter refers to a very vast field with a rich and well-documented history. At the beginning of the war, the Allied secret services received numerous reports on this.

Evidence of this is provided, for example, by a summary written by the British intelligence service, in which as early as 11 November 1939 these weapons are mentioned. Its author - Dr. RV Jones, an Oxford-based physicist and Head of Science Intelligence at the UK Air Ministry - mentioned the following in his report, among other things: [5]

> "...bacteriological weapons, new warfare gases, flamethrowers, glide bombs, pilotless aircraft aerial torpedoes, long-range guns and missiles, new torpedoes, mines and submarines, death rays, engine-killing rays, and magnetic mines



42

SECRET

SORTIE 3598

19 November, 1944.

. Upon taking off from base, the warning light for the landing gear did not go off when wheels were retracted. Before reaching the target this light went out when the ship hit some rough air.

As soon as the pilot entered the target area, around the Schuluch See, his electrical compass commenced spinning around, the magnetic compass became erratic, and the landing gear warning light came on again. To prevent any possible influence upon his engines, the pilot increased and decreased the R.P.M. by several hundred every few seconds. He commenced this as he approached the target area, and continued until he was well out of the area. He reported having no trouble with the engines, and, due to his preventative action, could not tell whether any foreign influence was exerted upon them.

While over the target area, the electrical compass continued spinning erratically. The pilot several times cut off the current to the compass. When turned back on the compass functioned normally for an instant in each case, and then spun about once more. Finally, he cut off the current until he crossed the Rhine en route to England. The compass then seemed to function normally, although it has not been checked for variation.

Arriving over England, the pilot found he could not receive radio communications on "A" channel, which is used for homing at base. His calls were received at base, but faintly, even though the pilot was positive he had been as near to base as Reading while calling. He was forced to home into Manston on another frequency. After taking off from Manston for base, under the overcast, he did not attempt to use "A" channel until within sight of base. He could then receive all right. No work had been performed on the radio at Manston.

The pilot was examined by the squadron flight surgeon about two hours after landing at base. His pulse and temperature were normal, and there was no evidence that he had been subjected to a high frequency field.

One camera on the aircraft failed to operate, while the others functioned normally. Whether this was a common malfunction or not is unknown.

Conclusion: All malfunctioning instruments were removed and sent to the nearest U.S. Air Force instruments specialists. This check included very thorough examination of the compass, camera and radio apparatus. These last three items had definitely not been affected by residual magnetism or any magnetic ray and in each case a common mechanical fault was found to have been the cause of trouble. After correcting faults a flight check showed everything to be again functioning normally.

APPENDIX "G"

JOHN A. O'HARA
Lt. Col. AC
Technical Section
Directorate of Intelligence, USSTAF.

As it later turned out, this was only the beginning of large-scale research programs. I have to say that during my archive search I never attempted to find material that referred to such research. Nevertheless, I came across numerous documents on this subject almost by accident. Inevitably, one gets the impression that these works, which have now practically fallen into oblivion, were designed on a grand scale.

Many American secret service reports were made available to me in the form of copies by Fr. Henry Stevens from the USA (unfortunately without signatures). The entire first part of this chapter is based on these documents.

The first "serious" report that forced the officers of the Western secret services to deal with this topic more closely may serve as a starting point for the description of this complex of topics. The event took place in mid-November 1944, and its first reasonably accurate description was part of an appendix to a special report dated November 16, 1944 (Document 42). This refers to the American reconnaissance aircraft P-38. Here is the translation:

SECRET
FLIGHT 3598
November 19, 1944

After takeoff from the airbase, the landing gear retract warning light did not go out, even though the landing gear had been retracted. It only went out when the pilot got into a bad weather zone before reaching the destination. When he reached the target area near the Schuluchsee, his electric compass began to spin in circles, the magnetic compass reading was erratic, and the undercarriage warning light came on again. As the pilot approached the target area, the pilot alternately reduced and increased the speed of the aircraft's engines by several hundred revolutions per minute every few seconds to eliminate any possible impact on the aircraft's propulsion system. He only completed this maneuver when he had left the target far behind. He explained that he had no problems with the engines. Due to his precautionary measures, however, he could also

not say whether an attempt was made to influence the drive system.

While crossing the target, the electric compass kept spinning chaotically in circles. The pilot repeatedly interrupted the power supply to the compass. Each time the compass was turned back on, it worked normally for a moment, but then started spinning again. Finally, the pilot turned off the power until he had crossed the Rhine and headed for England. Thereafter the compass functioned normally again, although it was not checked for a possible deviation.

As the pilot approached England, he noticed that he was unable to establish a radio link on channel "A", which is used on the approach to the airbase. His messages could only be received very weakly from the base, although he was in the immediate vicinity. He was forced to continue his flight towards Manston and had to use a different frequency.

After taking off from Manston and flying back to his base, the pilot refrained from using channel "A" until he had visual contact. After that he was able to receive normally again.
The radio system was not examined during the stay in Manston.

About two hours after landing at the base, the pilot was examined by the squadron doctor. His heart rate and body temperature were normal, and no evidence was found that he had been exposed to a radiofrequency field.
[The Americans knew what they were looking for! – note d. author]
One of the plane's cameras was inoperable, but the other two worked perfectly. It could not be determined whether this was one of the usual defects.

In conclusion, all onboard instruments that failed during the flight were dismantled and sent to the nearest qualified American Air Force specialist for examination. This inspection included a very thorough examination of the compass, still camera and radio equipment.

The three instruments showed no traces of magnetization or exposure to any magnetic radiation. In all cases it was determined that the malfunction had purely mechanical causes. A subsequent flight test showed that the devices worked correctly after the faults had been eliminated.

Annex "G"
John A. O'Mara, Col. AC
Technical Division
Head of Intelligence, USSTAF

Exactly at the same time as the mentioned report was written, namely on November 16, 1944, the American Department of War (Department of Defense) for the first time summarized information about possible new German weapons that were connected to the "adventures" of the mentioned reconnaissance aircraft could. Only now did it turn out that this was not the first report on this subject and that the Americans knew very well in which direction the work of the Germans was going. Here is the summary mentioned (Document 1):

SECRET
DEPARTMENT OF WAR
MILITARY INTELLIGENCE, WASHINGTON November 16, 1944

SUBJECT: Analysis of Reports of Jets or Charges to Neutralize Aircraft Engines.

TO: Major FJ Smith, PO Box 2610, Washington, DC

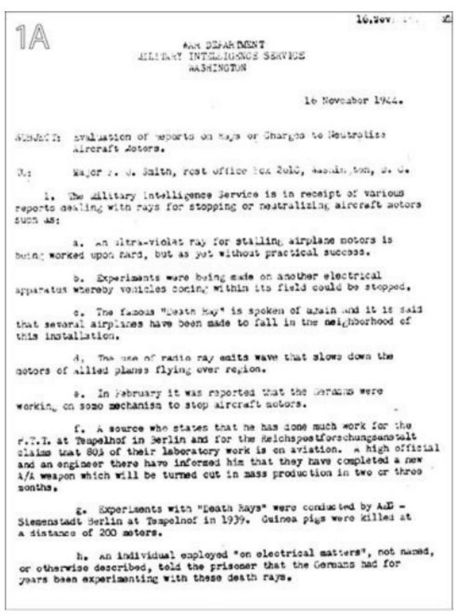
1. Military Intelligence has received various reports of Radiation for Shutdown or Neutralization [damage? – note d. author] of aircraft engines.
   Examples:
   a) Intensive research is being carried out on the ultraviolet ray [a bundle of ultraviolet rays - ed. author] carried out to bring aircraft engines to a standstill. This work has so far not been successful.

b) Work was being done on another electrical device intended to stop vehicles coming within the field generated by this device.

c) There are rumors about the infamous "death ray" again; it is claimed that many planes have been shot down in the vicinity of this facility (which produces this jet). d) Use of radio waves to reduce the engine speed of Allied aircraft overflying the area.

e) In February (1944) it was reported that the Germans were working on a (new) method of shutting down aircraft engines.

f) A source who claims to have worked for the PTT (Post, Telephone and Telegraph) in Tempelhof (Berlin) for a long time and for the Reichspostforschungsanstalt states that 80% of the laboratory work of these companies relates to aviation. A senior official employed there and an engineer have informed this source that work on a new anti-aircraft weapon, which should be put into mass production within two to three months, has been completed.


1A

16.Nov. [illegible]

WAR DEPARTMENT
MILITARY INTELLIGENCE SERVICE
WASHINGTON

16 November 1944.

SUBJECT: Evaluation of Reports on Rays or Charges to Neutralize Aircraft Motors.

TO: Major [illegible] Smith, Post Office Box 2610, Washington, D. C.

1. The Military Intelligence Service is in receipt of various reports dealing with rays for stopping or neutralizing aircraft motors such as:

a. An ultra-violet ray for stalling airplane motors is being worked upon hard, but as yet without practical success.

b. Experiments were being made on another electrical apparatus whereby vehicles coming within its field could be stopped.

c. The famous "Death Ray" is spoken of again and it is said that several airplanes have been made to fall in the neighborhood of this installation.

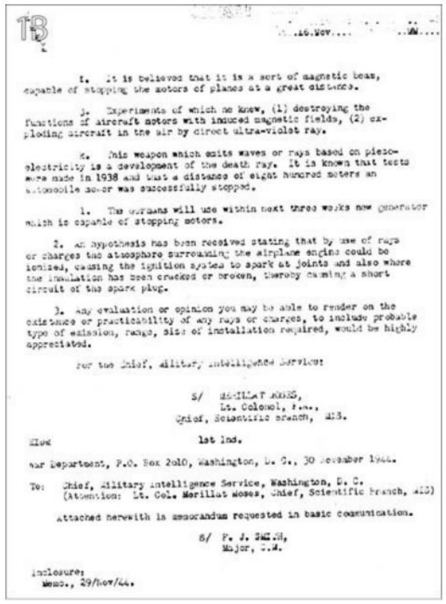
d. The use of radio ray emits wave that slows down the motors of allied planes flying over region.

e. In February it was reported that the Germans were working on some mechanism to stop aircraft motors.

f. A source who states that he has done much work for the P.T.T. at Tempelhof in Berlin and for the Reichspostforschungsanstalt claims that 80% of their laboratory work is on aviation. A high official and an engineer there have informed him that they have completed a new A/A weapon which will be turned out in mass production in two or three months.

g. Experiments with "Death Rays" were conducted by A.E.G. - Siemenstadt Berlin at Tempelhof in 1939. Guinea pigs were killed at a distance of 200 meters.

h. An individual employed "on electrical matters", not named, or otherwise described, told the prisoner that the Germans had for years been experimenting with these death rays.



1B

...16.Nov....

i. It is believed that it is a sort of magnetic beam, capable of stopping the motors of planes at a great distance.

j. Experiments of which he knew, (1) destroying the functions of aircraft motors with induced magnetic fields, (2) exploding aircraft in the air by direct ultra-violet ray.

k. This weapon which emits waves or rays based on piezo-electricity is a development of the death ray. It is known that tests were made in 1938 and that a distance of eight hundred meters an automobile motor was successfully stopped.

1. The Germans will use within next three weeks new generator which is capable of stopping motors.

2. An hypothesis has been received stating that by use of rays or charges the atmosphere surrounding the airplane engine could be ionized, causing the ignition system to spark at joints and also where the insulation has been cracked or broken, thereby causing a short circuit of the spark plug.

3. Any evaluation or opinion you may be able to render on the existence or practicability of any rays or charges, to include probable type of emission, range, size of installation required, would be highly appreciated.

For the Chief, Military Intelligence Service:

S/ MERILLAT MOSES,
Lt. Colonel, [illegible]
Chief, Scientific Branch, MIS.

[illegible] 1st Ind.

War Department, P.O. Box 2010, Washington, D. C., 30 November 1944.

To: Chief, Military Intelligence Service, Washington, D. C.
(Attention: Lt. Col. Merillat Moses, Chief, Scientific Branch, MIS)

Attached herewith is memorandum requested in basic communication.

S/ F. J. SMITH,
Major, C.E.

Inclosure:
Memo., 29/Nov/44.

g) Experiments with "death rays" were carried out as early as 1939 by AEG Berlin-Siemensstadt in Tempelhof. Guinea pigs were killed at a distance of 200 meters.

h) A person of whom neither personal data nor a detailed description is available and who dealt with "electrical questions" told a prisoner (or a prisoner of war) that the Germans had been conducting experiments with these rays for years.

i) It is believed to be a type of magnetic beam capable of stopping aircraft engines from a great distance.

j) The above person knew that the following experiments had been carried out: destroying aircraft engines (1) by induced magnetic fields, (2) creating explosions in flying aircraft using a directed beam of ultraviolet rays. k) This weapon, which emits waves or rays based on the piezoelectric effect, is a further development of

the death ray. It is known that corresponding tests were carried out in 1938; thereby managed to detect a running vehicle engine from a distance of 800 meters

to stop

l) The Germans will deploy a new generator capable of stopping engines within the next three weeks.

2. It was hypothesized that the radiation or charges could ionize the air surrounding the engine, causing sparking at the junctions of the ignition system and at points of damaged insulation, which in turn would cause short circuits in the spark plug supply circuits.

3. If you could provide any analysis or assessment relating to the existence or usefulness of any radiation or charge, taking into account possible emission modes, range and size of installation required, it would be of great benefit.

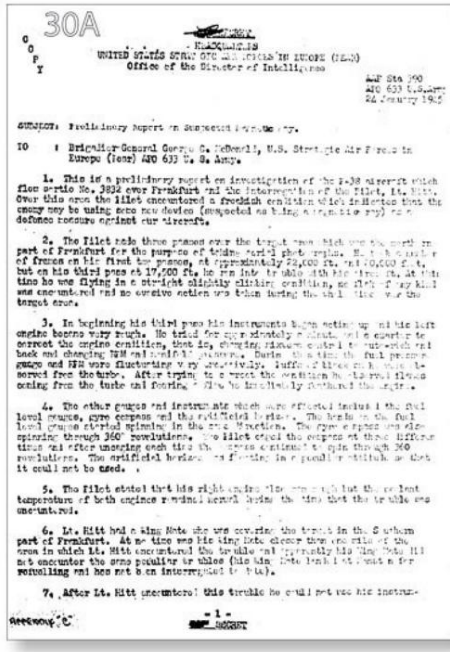
To the Chief of Military Intelligence:

Merillat Moses,
Colonel FA

Head of the scientific department

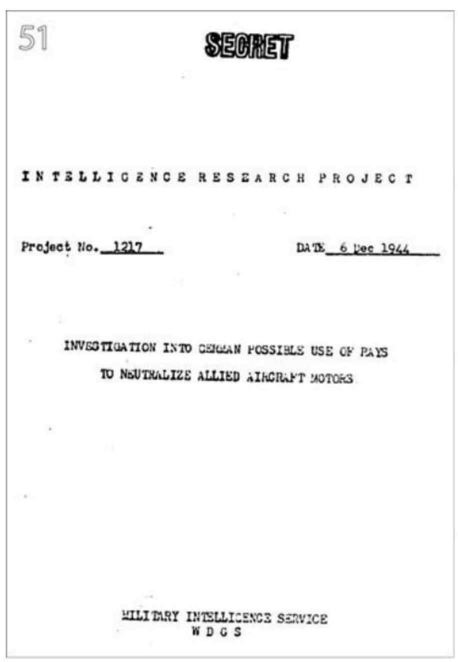
The US military intelligence service analyzed and collected information about the German "death rays" until the end of the war - and even afterwards. Even the case of the aforementioned P-38 reconnaissance aircraft (whose pilot was a certain Oberleutnant Hitt) led to detailed analyzes as late as January 1945 (see Document 30). The most important result of these investigations was the creation of a comprehensive research project at the end of 1944, which was intended to provide possible physical explanations for the observed effects (Document 51).

Although initially almost all possible explanations were considered - even substances sprayed in front of the aircraft, a hypothesis crystallized relatively quickly -, It was agreed that, from a practical point of view, the only plausible solution would be to construct an electromagnetic wave generator (at radio frequency) that would induce currents in all of the aircraft's circuits.



The calculations carried out showed that a wave with a frequency of 75 kHz (i.e. in the long-wave range) could achieve the greatest “penetration” of the beam of rays with a one millimeter thick aircraft outer skin (duralumin). However, in order to have enough energy to destroy aircraft circuits within a range of 5 square miles

(approx. 16 km2) would require thousands of tons of cables and a power consumption of several hundred megawatts. This referred to the variant (long wave) analyzed by the Americans, in which there was practically no possibility of bundling and focusing this energy on selected targets. The American analysts left out another possibility: a significant increase in the frequency of the radiation beam, up to the "radar" frequency, means that the aircraft skin increasingly reflects the electromagnetic wave, but at the same time the wave is easier to focus - despite worse "Penetration" can therefore achieve a stronger effect with less power consumption. At the time, the Americans did not know that the Germans had chosen precisely this path. However, as part of the aforementioned analysis, it was also established that, even in the case of long waves, a beam with a power a hundred times lower than that resulting from initial calculations was sufficient to create sparks in the aircraft's circuitry (rather than destroying it).


51

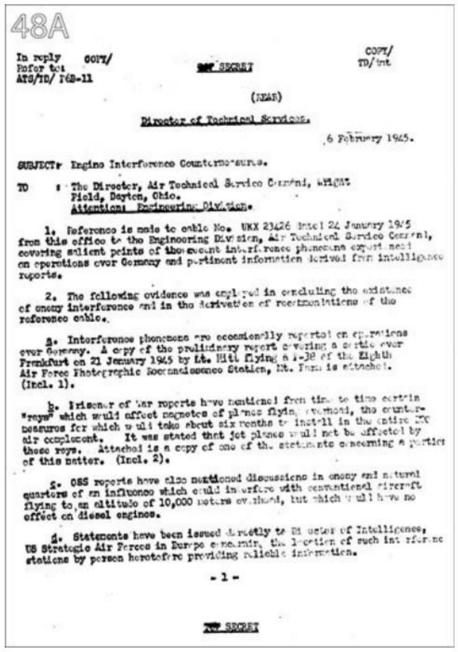
SECRET

INTELLIGENCE RESEARCH PROJECT

Project No. 1217 DATE 6 Dec 1944

INVESTIGATION INTO GERMAN POSSIBLE USE OF RAYS
TO NEUTRALIZE ALLIED AIRCRAFT MOTORS

MILITARY INTELLIGENCE SERVICE
W D G S



48A

In reply COPY/
Refer to:
ATS/TD/ 768-11

COPY/
TD/Int

TOP SECRET

(REAR)

Director of Technical Services.

6 February 1945.

SUBJECT: Engine Interference Countermeasures.

TO : The Director, Air Technical Service Command, Wright Field, Dayton, Ohio.
Attention: Engineering Division.

1. Reference is made to cable No. UKX 23426 dated 24 January 1945 from this office to the Engineering Division, Air Technical Service Command, covering salient points of the recent interference phenomena experienced on operations over Germany and pertinent information derived from intelligence reports.

2. The following evidence was employed in concluding the existence of enemy interference and in the derivation of recommendations of the reference cable.

a. Interference phenomena are occasionally reported on operations over Germany. A copy of the preliminary report covering a sortie over Frankfurt on 21 January 1945 by Lt. [illegible] flying a F-38 of the Eighth Air Force Photographic Reconnaissance Station, Mt. Farm is attached. (Incl. 1).

b. Prisoner of war reports have mentioned from time to time certain "rays" which would affect magnetos of planes flying overhead, the countermeasures for which would take about six months to install in the entire [illegible] air complement. It was stated that jet planes would not be affected by these rays. Attached is a copy of one of the statements concerning a portion of this matter. (Incl. 2).

c. OSS reports have also mentioned discussions in enemy and natural quarters of an influence which could interfere with conventional aircraft flying to an altitude of 10,000 meters overhead, but which would have no effect on diesel engines.

d. Statements have been issued directly to Director of Intelligence, US Strategic Air Forces in Europe concerning the location of such interference stations by person heretofore providing reliable information.

- 1 -

TOP SECRET

Based on the report mentioned, work soon began on possible countermeasures for this new German weapon. As a result, on February 6, 1945, the head of the technical services of the American Air Force, Colonel Bunker, prepared a voluminous document with recommendations for flight formations aimed at reducing the sensitivity of aircraft to the described energy (Document 48). His addressee was the head of the technical intelligence service of the American Air Force at the Wright Field air base near Dayton in the state of Ohio.

However, this letter takes the position that the most effective strategy under the given conditions is to collect information about the locations of the German installations and to avoid them until more data becomes available. It was thought that jet-powered aircraft would be immune to the effects of the energy mentioned, suggesting that in the future this type of aircraft could operate over the areas in question. In the meantime, attempts were made to obtain more intelligence information in order to be able to better assess the danger. However, the information obtained was still only fragmentary: it consisted of short reports that did not provide any basis for a more or less comprehensive explanation of the phenomenon until the end of the war

could. An example of such a report is Document 5 of January 25, 1945, a summary of the testimony of a German prisoner of war who states that work in this area had been carried out as early as 1934, and with success. At that time it was possible to bring a combustion engine to a standstill at a distance of 150 meters. A little later, but before the outbreak of war - in 1938 - two German aircraft manufacturers were commissioned to develop a similar weapon that would affect the engines of enemy aircraft. This work was carried out somewhere "between Augsburg and Munich".

48B

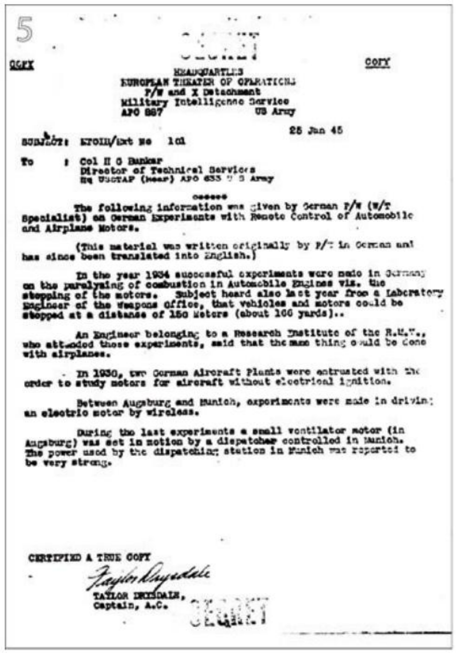
[redacted] SECRET

3. However incredible it may appear to project from the ground to a height of 30,000 feet sufficient magnetic energy to interfere with the functioning of the ignition system of an airplane, it is believed that the above evidence nevertheless justifies the consideration of countermeasures for such a condition.

4. A possible explanation of the fouling of both intake and exhaust plugs of only one bank of cylinders in the port engine, and only partial interference with the starboard engine of Lt. Hitt's plane may lie in the design of the ignition system. In each engine, one of the magnetos activates the intake plugs of both banks. The The ignition sequence requires that firing occur in each bank alternatively. This is accomplished by the distributor circuitry and employment of alternating currents and corresponding alternating magnetic fields in the magnetos. Thus interference could be effected in the firing of one bank of cylinders by synchronising (1) a pulse of opposing field with every other contact of the distributors, or (2) an alternating field with every contact of the distributor, if the frequency of the interfering field is twice, or a multiple of twice, the frequency of the ac used in the magnetos. Thus (with sufficient magnetic energy available) every other pulse of the voltage from the magnetos may be reduced by the interfering field of opposite polarity to a value insufficient to break down the gap of the plugs. Such a condition would cause fouling of one bank of cylinders in the motor with which the interference is synchronized, and may cause partial interference with the operation of the other motor with which it is not in perfect synchronization. The freedom from either engine or instrument interference experienced by the other aircraft flying with Lt. Hitt may be explained by a supposition of beaming or concentration of energy on the north side with consequent reduction on the south side of the Main River.

5. It is realized that the points of the above discussion are by no means conclusive. It is further understood that some of the ideas considered herein are improbable from our present scientific viewpoints. But if the evidence gathered on operational flights may be correlated with information provided by intelligence sources, it must be concluded that the enemy not only intends to interfere with our aircraft by some immaterial means, but also has succeeded in accomplishing this intention to a limited extent. The means and countermeasures suggested have not had the benefit of laboratory analysis or the corroboration of later evidence, but they are forwarded in their present form to reduce delay to the minimum. Further information on this and later events concerning this subject will be transmitted immediately to Wright Field where it is

- 2 -



5

SECRET

COPY COPY

HEADQUARTERS
EUROPEAN THEATER OF OPERATIONS
P/W and X Detachment
Military Intelligence Service
APO 887 US Army

25 Jan 45

SUBJECT: ETOIII/Ext No 101

To : Col H G Bunker
Director of Technical Services
Hq USSTAF (Rear) APO 633 U S Army

oooooo

The following information was given by German P/W (W/T Specialist) on German Experiments with Remote Control of Automobile and Airplane Motors.

(This material was written originally by P/W in German and has since been translated into English.)

In the year 1934 successful experiments were made in Germany on the paralyzing of combustion in Automobile Engines viz. the stopping of the motors. Subject heard also last year from a Laboratory Engineer of the Weapons Office, that vehicles and motors could be stopped at a distance of 150 Meters (about 166 yards)..

An Engineer belonging to a Research Institute of the R.M.T., who attended those experiments, said that the same thing could be done with airplanes.

In 1930, two German Aircraft Plants were entrusted with the order to study motors for aircraft without electrical ignition.

Between Augsburg and Munich, experiments were made in driving an electric motor by wireless.

During the last experiments a small ventilator motor (in Augsburg) was set in motion by a dispatcher controlled in Munich. The power used by the dispatching station in Munich was reported to be very strong.

CERTIFIED A TRUE COPY

Taylor Drysdale

TAYLOR DRYSDALE,
Captain, A.C.

SECRET

As can be seen, despite investigations lasting more than a decade, information about the full extent of the works never got into the hands of the enemy, at least not the enemy in the west...

The mystery of the German "death rays" could only be solved long after the war. The information currently available indicates that the work followed two main directions. The first (although not the only one) is related to the aforementioned effect on engines and other systems of enemy aircraft. We know that this work is inextricably linked to research on radar devices and is, in a way, a side effect of this research. We know this because the labs that designed one of these powerful systems mostly designed radar equipment. We are talking about the so-called GEMA works in the town of Lubaÿ (then Lauban) in Lower Silesia. Leszek Adamczewski - a journalist who has been dealing with this topic for a long time - wrote: 49

“After I published an appeal in the *Przeglÿd Lubaÿski* newspaper for people who were in Lubaÿ during the war or shortly after it and heard or saw something about mysterious phenomena to contact us, we received tips from our readers. They brought a fountain discovered in the park with the super secret activity of the GEMA

works in connection.

The GEMA armaments factory was relocated from Berlin, which was being bombed by the Allies, to Lubaÿ to Gustav Winkler's then modern factories. According to the information available to me, an extremely secret radar technology program was being developed there. Next door was the city's largest labor camp, the 'GEMA dormitory camp', which housed mainly Russian and Polish women.

The recently deceased Stanisÿaw Siorek, explorer and officer of the Security Service of the People's Republic of Poland, claimed shortly before his death that the well accidentally discovered in the park near Esperantystów Street was nothing more and nothing less than an old underground ventilation or salvage shaft Part of the GEMA works, which were most likely flooded at the end of the war.

One who responded to the call was Józef Bujak from Lubaÿ. He came to the city shortly after the war and worked in a motor winding shop that also employed an old German by the name of Glaubich, who informed Bujak of mysterious experiments being carried out in the GEMA works in the final stages of the war.

They were based - Bujak recalled - on the generation of some electromagnetic field because the vehicles driving past the GEMA works stopped! This could be observed over a distance of about 300 meters. A section of the road between Lauban and Görlitz used to be closed to traffic. When the attempt was aborted, the vehicles just kept going as if nothing had happened. I believe he saw not only spark ignition vehicles stop, but diesel vehicles as well!

I can't explain that in any way ...

Bujak went several times to the ruins of the GEMA works that had been set on fire by the retreating Germans. On the factory site there were metal constructions about 15 meters high with a cabin attached below. These designs were rotatable, and the cabins were crammed with electronics.

'Of course, these electronics can't be compared to today's,' Bujak adds, 'but they looked like complicated radios.' could not be discovered today. And, most likely, this was not the only complex involved in these researches.

However, the work mentioned above, ie the construction of systems for emitting bundled radio waves, which, due to their power and frequency, could interrupt or damage electrical circuits of overflying aircraft, was not all that the Germans were working on in the field of so-called "electromagnetic weapons".

Indeed, it is known that, among other things, work was also being done on a type of “X-ray laser” – a source of coherent X-rays or gamma rays known to be lethal to living organisms at high intensity.

A search in German archives revealed that in the spring of 1944 a special Luftwaffe research facility in Großostheim had been commissioned to develop such a weapon. The documents on this work are currently in a civilian facility - the Karlsruhe Research Center - and were disclosed several years ago, including a comprehensive study on the subject dated July 12, 1944, which was prepared for the Luftwaffe command.

Unfortunately, the copy of the report is in such poor condition that much of it is illegible.

Nevertheless, it can be concluded that the Germans were working on three different versions of the deadly emitter and that it would have been perfectly possible for the Third Reich to build such an anti-aircraft weapon. It would also have been operational within a relatively short time, ie before the end of the war. The third and most advanced version of the weapon was intended to irradiate a target at a distance of five kilometers at an intensity of seven radians per second for 30 seconds, which - as stated in the report - would have been quite enough to completely incapacitate the crew of an aircraft to put out of action. In the case of a target located at a different altitude, a correspondingly shorter or longer irradiation time would be required. Interestingly, this report also found that the target aircraft's aluminum skin hampered the effectiveness of the new

weapon on living organisms would increase rather than decrease. In this case, the outer skin would have the effect of a microwave oven. The issue of using X-ray generators in combat remains unclear to this day. However, if this weapon was ever used, it was certainly on a small scale. Similar to the other revolutionary concepts described in this book, however, one question still remains: Are such weapons part of modern arsenals, and if so, to what extent?

Despite the pioneering nature of these developments, it is evident that the scientists of the Third Reich were working on an even more advanced armament - the so-called "particle beam weapon" - a emitter of high-energy particles or ions which, like invisible "micro-projectiles", hit living targets and their kinetic converting energy into lethal radiation only at the moment of impact. In the case of atoms of heavy elements, even single ions would most likely be enough to kill the victim.

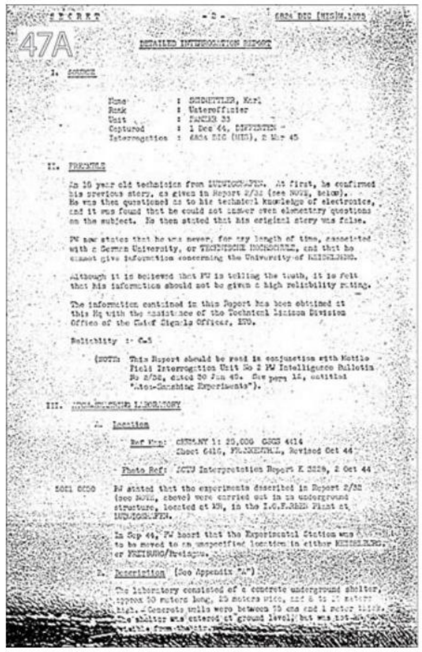
As far as I know, no calculations have been made for such a variant; however, it is no secret that even a single quantum of high-energy gamma radiation (i.e. a single photon!) could kill a human being and even raise the brain temperature by several degrees if it hits the head, regardless of any secondary radiation that may be present. However, electromagnetic radiation with such gigantic power can only be generated at enormous cost and on the smallest level, namely in the largest particle accelerators.

However, a heavy metal ion could perform this task much better and would be one of the best candidates for the "perfect weapon of the future". Of course, only heavy ions would come into question, which would be accelerated to a speed close to the speed of light. By the way, some time ago I received information about the rather mysterious death of two people (which happened in modern times, but not in Poland). During the investigation, microscopic holes were discovered in window panes, the diameter of which was only about 0.5 mm. Its rims were melted, but there was not a single crack in the glass. So maybe someone is already mastering this lethal technology at a much higher level than the Germans did during WWII...

Documents from the US military intelligence service provide solid information about the work they have carried out. The first relatively comprehensive account is the testimony of a German prisoner of war - a certain Karl Schnettler, who was captured on December 1, 1944. His statement (the record is reproduced in this book as Document 47) thus necessarily refers to an earlier time. Schnettler explained that experiments with the particle beam weapon had been carried out in an underground laboratory near Ludwigshafen that belonged to the IG Farben concern. In September 1944 it was to be relocated to the Heidelberg or Freiburg region. However, the prisoner knew nothing about the experiments carried out there.

For this he described in detail the laboratory near Ludwigshafen. The tests were carried out in an underground bunker with internal dimensions of 25 x 50 meters and a height of eight to ten metres. The bunker walls would have been up to one meter thick. Above the ground, at a height of about two meters, there was a long platform, four to five meters wide, covered with a plastic layer of igelite, three to five centimeters thick. At one end of the bunker there was a niche where 'electron tubes' (ion guns?) called *'fang poles'* and *'spray poles* ' stood on special trolleys. Before the start of the experiment, these "tubes" were brought into the "bundling zone", which was shielded with a semi-circular quartz plate. A niche at the other end of the bunker housed the electrical measurement and control systems, which were also protected by such a panel. In front of it was the actual target area of the "tubes", which were probably ion or particle cannons. It was a 1.25 - 1.5 m high cuboid column surrounded by massive quartz plates, two inches thick. It is clear from the text that these plates formed a kind of “aquarium” connected to a vacuum pump. All elements of the target were covered with a thin layer of Igelit plastic.

The statement also includes the description of an experiment carried out on rats in April 1944: they died instantly, phosphorescence of their bodies being observed for a split second during the time they were exposed to the effects of the radiation.



47A

SECRET - 2 - 6824 DIC [MIS]M.1079

DETAILED INTERROGATION REPORT

I. SOURCE

Name : SCHNETTLER, Karl
Rank : Unteroffizier
Unit : PANZER 33
Captured : 1 Dec 44, [illegible]
Interrogation : 6824 DIC (MIS), 2 Mar 45

II. PREAMBLE

An 18 year old technician from LUDWIGSHAFEN. At first, he confirmed his previous story, as given in Report 2/32 (see NOTE, below). He was then questioned as to his technical knowledge of electronics, and it was found that he could not answer even elementary questions on the subject. He then stated that his original story was false.

PW now states that he was never, for any length of time, associated with a German University, or TECHNISCHE HOCHSCHULE, and that he cannot give information concerning the University of HEIDELBERG.

Although it is believed that PW is telling the truth, it is felt that his information should not be given a high reliability rating.

The information contained in this Report has been obtained at this Hq with the assistance of the Technical Liaison Division Office of the Chief Signals Officer, ETO.

Reliability : C-3

(NOTE: This Report should be read in conjunction with Mobile Field Interrogation Unit No 2 PW Intelligence Bulletin No 2/32, dated 30 Jan 45. See para 14, entitled "Atom-Smashing Experiments").

III. [illegible] LABORATORY

A. Location

Ref Map: GERMANY 1: 25,000 GSGS 4414 Sheet 6416, [illegible], Revised Oct 44

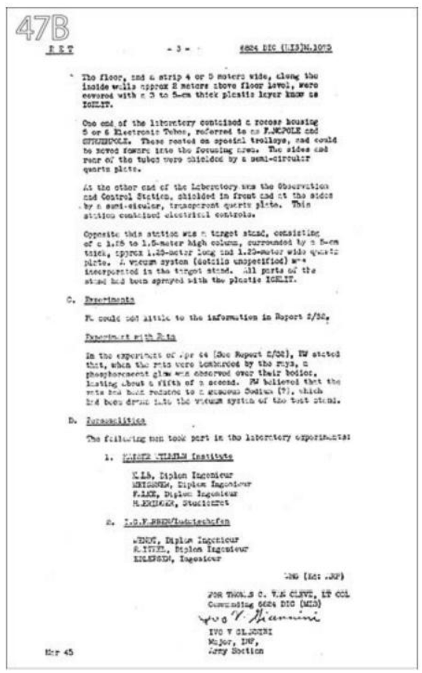
Photo Ref: [illegible] Interpretation Report [illegible], 2 Oct 44

[illegible] PW stated that the experiments described in Report 2/32 (see NOTE, above) were carried out in an underground structure, located at [illegible], in the I.G.FARBEN Plant at LUDWIGSHAFEN.

In Sep 44, PW heard that the Experimental Station was to be moved to an unspecified location in either [illegible] or FREIBURG/Breisgau.

B. Description (See Appendix "A")

The laboratory consisted of a concrete underground shelter, approx 30 meters long, 25 meters wide, and [illegible] meters high. Concrete walls were between [illegible] cms and 1 meter thick. The shelter was entered at ground level, but was not [illegible] visible from the air.



47B

[illegible]RET - 3 - 6824 DIC (MIS)M.1079

The floor, and a strip 4 or 5 meters wide, along the inside walls approx 2 meters above floor level, were covered with a 3 to 5-cm thick plastic layer know as IGELIT.

One end of the laboratory contained a recess housing 5 or 6 Electronic Tubes, referred to as [illegible] and [illegible]. These rested on special trolleys, and could be moved forward into the focusing area. The sides and rear of the tubes were shielded by a semi-circular quartz plate.

At the other end of the laboratory was the Observation and Control Station, shielded in front and at the sides by a semi-circular, transparent quartz plate. This station contained electrical controls.

Opposite this station was a target stand, consisting of a 1.25 to 1.5-meter high column, surrounded by a 5-cm thick, approx 1.25-meter long and 1.25-meter wide quartz plate. A vacuum system (details unspecified) was incorporated in the target stand. All parts of the stand had been sprayed with the plastic IGELIT.

C. Experiments

PW could add little to the information in Report 2/32.

Experiment with Rats

In the experiment of Apr 44 (See Report 2/32), PW stated that, when the rats were bombarded by the rays, a phosphorescent glow was observed over their bodies, lasting about a fifth of a second. PW believed that the rats had been reduced to a gaseous Sodium (?), which had been drawn into the vacuum system of the test stand.

D. Personalities

The following men took part in the laboratory experiments:

1. KAISER WILHELM Institute

KALB, Diplom Ingenieur
MEISSNER, Diplom Ingenieur
FALKE, Diplom Ingenieur
[illegible], Studienrat

2. I.G.FARBEN/Ludwigshafen

[illegible], Diplom Ingenieur
[illegible], Diplom Ingenieur
[illegible], Ingenieur

[illegible]

FOR THOMAS C. VAN CLEVE, LT COL
Commanding 6824 DIC (MIS)

Ivo V. Giannini

IVO V GIANNINI
Major, INF,
Army Section

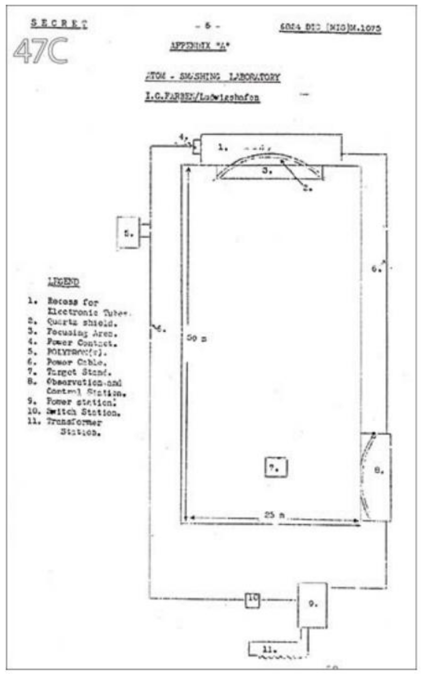
[illegible] Mar 45

Schnettler claimed their bodies immediately decomposed and sucked out in the form of gas (literally: sodium vapor) by the vacuum pump. This claim was evidently met with skepticism by the interrogating officers, who put a question mark in parentheses at the end of this sentence.

The prisoner also gave a number of names of scientists who took part in these works. From the Kaiser Wilhelm Institute these were the engineers Kalb, Meissner, Falke and the intern

Haeringer, from the IG Farben group in Ludwigshafen, the engineers Wendt, Raithel (or Raitrel) and Edlefsen.

In document 47C you see a sketch of the laboratory in Ludwigshafen, which was attached to the American report.



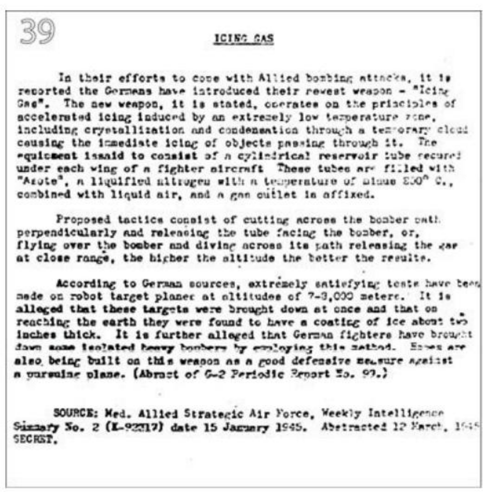
In their search for new, unconventional anti-aircraft weapons and in the hope that precisely these unusual methods would prove effective against the incessant barrage of American and British bombers, the leadership of the Third Reich even resorted to such a strange "weapon" as clouds cause icing of enemy aircraft. Of course, this is about artificially generated clouds.

It is well known that aircraft icing is a very serious problem and the effectiveness of the de-icing system (electric heating) is a prerequisite for safe flight.

Even in summer, at an altitude of several thousand meters, the temperature is always below zero, and there is always a certain amount of water in the form of gas in the air, regardless of the presence of clouds. Under certain circumstances, which depend on humidity, air pressure and temperature, this water can condense. One can influence these circumstances by adding additional water to the atmosphere

bring in the process also becomes much more efficient if substances that promote the condensation of the water are used instead. The most effective are various types of free radicals that form a condensation nucleus, as well as crystals of certain substances or gases that crystallize in the air, forming microscopic “grains” around which water vapor condenses, becoming water droplets and eventually ice crystals. At certain altitudes, even smoke becomes a very effective means of condensing water vapor. If meteorological knowledge is used for this purpose and weather conditions are favourable, a serious threat to enemy aircraft can be created at a surprisingly low cost (compared to complicated armament systems). Such methods were developed in various countries after the war and were used - but never as a weapon, according to the available data.

Light unguided rockets were developed in the Soviet Union in the 1960s (very simple and cheap) with warheads filled with powdered silver iodide (AgI). They were used as a very effective way of protecting sensitive cotton fields from thunderstorms and hailstorms. With this method, a "barrage" of condensation nuclei was built up before an approaching weather front, which allowed the clouds to "shed" their ballast before reaching the fields.



39

ICING GAS

In their efforts to cope with Allied bombing attacks, it is reported the Germans have introduced their newest weapon - "Icing Gas". The new weapon, it is stated, operates on the principles of accelerated icing induced by an extremely low temperature zone, including crystallization and condensation through a temporary cloud causing the immediate icing of objects passing through it. The equipment issaid to consist of a cylindrical reservoir tube secured under each wing of a fighter aircraft These tubes are filled with "Azote", a liquified nitrogen with a temperature of minus 200° C., combined with liquid air, and a gas outlet is affixed.

Proposed tactics consist of cutting across the bomber path perpendicularly and releasing the tube facing the bomber, or, flying over the bomber and diving across its path releasing the gas at close range, the higher the altitude the better the results.

According to German sources, extremely satisfying tests have been made on robot target planes at altitudes of 7-8,000 meters. It is alleged that these targets were brought down at once and that on reaching the earth they were found to have a coating of ice about two inches thick. It is further alleged that German fighters have brought down some isolated heavy bombers by employing this method. Bases are also being built on this weapon as a good defensive measure against a pursuing plane. (Abract of G-2 Periodic Report No. 97.)

SOURCE: Med. Allied Strategic Air Force, Weekly Intelligence Summary No. 2 (K-92317) date 15 January 1945. Abstracted 12 March, 1945 SECRET.

This phenomenon is currently being exploited in the Republic of South Africa, but using much simpler means. Dense clouds covering dry and under normal conditions barren fields

are "forced" to rain down with the help of ordinary smoke candles. Several such smoke candles are hung under the wings of a light aircraft, which then flies into the clouds, where the pilot ignites them electrically. This method is so effective that two to four candles during a flight are usually sufficient to produce precipitation.

But what were the Germans working on?

Once again, we find the answer to this question in the declassified documents of the US military intelligence service. Information on this subject is also found in one of the reports relating to new German weapons (Document 39). It contains the following description:

> “It is reported that the Germans, in their efforts to counter the Allied bombing raids, introduced their newest weapon – the 'ice gas'. The new weapon is said to be based on the phenomenon of accelerated icing, in which condensation and crystallization processes are produced by a cloud in an extremely low temperature zone. Any object that passes through this cloud is immediately frozen. The equipment needed to create such an effect consists of two cylindrical containers suspended under the wings of a fighter plane, filled with liquid nitrogen (mixed with liquid air) at a temperature of minus 250 °C and fitted with a gas outlet.

> The proposed tactic is to cut vertically through bombers' line of flight and release the gas in front of them, or fly over the bomber and then dive, which would allow the gas to be released at a shorter distance from the target. The higher the flight altitude, the better the results would be.

> According to German sources, extremely successful tests were carried out with remote-controlled target aircraft at an altitude of 7,000 - 8,000 m. These targets are reported to have crashed instantly; after the crash, a layer of ice about 5 cm thick was found. Furthermore, it is assumed that German fighter planes had

thus 'shot down' a certain number of heavy bombers detached from the squadron. It is also hoped that this method will provide effective defense in pursuit flights.”

Other American documents contain information about experiments with other substances which, when sprayed in the air, were intended to damage the engines of enemy bombers. Document 52 describes these substances as follows: “Two types of gas are known which could be used against aircraft. One of them is intended to cause premature ignition, which would lead to the cylinder heads tearing off, the second to reduce the viscosity of oils used to lubricate the engine. Operating knowledge aside, these gases appear under laboratory conditions as if their application is actually possible. However, it is doubtful whether the enemy, with the appropriate escort of fighters, would be able to use any of these methods in concentrations that would have serious consequences. If missiles from anti-aircraft guns were used for this purpose, the achievable concentration would probably be no more dangerous than the accurate fire of conventional anti-aircraft artillery.”


44

SECRET

[illegible]

Letter from John [illegible], Director, [illegible], [illegible] Laboratory, [illegible] - U. S. ARMY to Dr. L. A. DuBridge, Director, [illegible] Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts

"[illegible]"

Probably inspired by the German development of V-1, V-2, and other military devices such as the jet aircraft and rockets, there appears to have developed a very strong "new weapons" psychosis which leads to reports of new and amazing phenomena every other week. I have recently been looking into the evidence for a reported enemy radiation capable of interfering with aircraft ignition up to [illegible],000 meters and operating [illegible] certain high-priority target areas. There is also the reported German pro-[illegible] gas capable of minute concentrations of removing aircraft engine heads. Not so long ago several pilots reported flying through thousands of transparent glasslike bubbles which, although they had no adverse effect, were thought to be [illegible] new weapon. A considerable number of ground and air observers saw new-weapon possibilities in an unusual pink cloud phenomenon which persisted for about an hour over the front line, but without any noticeably adverse effects. The explanations for the latter two items seem to be bundles of window dropped by a preceding high-altitude bomber formation and an actual pink-colored cloud respectively. There is the report of a "freezing gas" for icing up aircraft, and a host of others. Most of them have little effect and are quickly discredited. On the whole, they illustrate the interesting attitude of mind which has developed—but, with V-1 and V-2 as daily evidence, one has to be careful.

However, this is by no means the end of the list of unusual German concepts in the field of anti-aircraft weapons. The last of the documents presented (Document 44) betrays even stranger ideas, the meaning and exact purpose of which we can only guess at. Here's a short one

snippet:

> “[…] I recently saw evidence of reported enemy radiation capable of affecting aircraft ignition systems at a range of 3,000 meters and being used in the vicinity of certain high-priority targets. […] Not so long ago, many pilots reported flying through thousands of transparent 'bubbles' that resembled glass in appearance. Although they had no negative impact, it was assumed that this was a new weapon. Many observers within the ground and flight crew also see a new weapon in the unusual phenomenon of pink clouds hovering over the front line for about an hour, although these clouds also do not appear to be exerting any discernible negative influence.”

It seems that the “ice gas” even went into combat use. At least that's how Otto Skorzeny described it in his memoirs, who was fighting in the SS Division *Das Reich* at the time, i.e. around the turn of the year 1941/1942 : "To our left is the town of Chimki, the river port of Moscow. From[50] here it is only eight kilometers to Moscow. Without a single shot being fired,

> on the 30th

> The 62nd reconnaissance regiment, which belongs to Hoepner's tank corps, arrived there on November. Nobody knows why this opportunity was not taken. Our motorcyclists withdrew.
>
> Here begins the next mysterious episode of the struggle for Moscow, which escaped the attention of many historians. In order to be able to withstand the terrible rockets of the 'Stalin organ', a new rocket projectile filled with liquid air was used. The missiles resembled giant bombs and, as far as I could tell, their effect was unparalleled. Their use immediately affected the enemy's defensive strength. The enemy used huge loudspeakers for (seemingly extremely mundane and crude) propaganda purposes. A few days after the first use of our projectiles, the Russians threatened us over these loudspeakers that they would respond with a poison gas attack

would if we continued to use liquid air-filled rockets. From that moment these missiles were never used again, at least not in our sector. I don't think they were used on other fronts either."

However, the “ice weapon” also had a counterpart – a “firearm”.
In the early 1970s, the Americans used a "new" previously unknown weapon in Vietnam. The effects of the first application were appalling, but also highly unusual: when the Vietnamese inspection arrived at the scene of the attack, they found bodies scattered, frozen in strange postures... but showing no signs of any external injury. All that could be seen was that blood had flowed from the mouths of the dead. The unusual nature of these traces has led to allegations that a prohibited biological weapon was used. The Americans denied these allegations, and the full truth about the “new” weapon only came to light much later (many years later). As it turned out, this unusual weapon was actually used on a large scale for the first time – an unusual weapon, but one that belongs to the arsenal of conventional weapons. They were so-called aerosol bombs - aircraft bombs, but they bear little resemblance to classic bombs because they do not have a thick steel shell. The bomb is more of a bulbous, thin-walled, cylindrically-shaped container made of thick sheet metal. Apart from the detonator, it contains no explosives, instead it contains compressed methane or another volatile hydrocarbon (ethane, hexane or a special mixture). The peculiarity of the "new" weapon was that the explosive charge is formed only after the bomb has been dropped by mixing the contents with air (in an appropriate ratio).

The fundamental technical turning point now is that the resulting mixture does not burn, as e.g. B. in the cylinder of an internal combustion engine, but detonated. This difference requires an explanation: Combustion or deflagration (the burning of black powder or faint smoke powder in the barrel of a gun, the explosion of a firecracker, etc.) is characterized by the fact that the heat

represents the main agent of reaction expansion - or to put it another way: the flame, ie the propagating medium that has been heated up as a result of the reaction. The burning speed is usually relatively slow - it rarely exceeds 2,000 m/s. This parameter is related to the basic property of explosive combustion - its low destructive power.

The main agent of detonation transmission, on the other hand, is the so-called shock wave, which is something completely different. It is not directly related to the propagation of the medium - there is a difference between a shock wave and an air blast. The shock wave is more like a sound wave (the propagation of which is characterized only by an oscillation in air density and not by spatial displacement), but by definition it always travels faster than the sound and only becomes a sound wave when it attenuates. It reaches a speed of approx. 9,000 m/s, which is why there is an enormous density oscillation - and if matter did not have an atomic structure, this density would be infinite.

A typical aerosol bomb produces both a strong shock wave and a very strong expansion and heat wave. A canister of half a tonne of methane creates an explosion comparable in destructive power to the explosion of about 1.5 tons of TNT (a high-powered explosive), i.e. about three times as powerful. In practice, however, it is much stronger, since the envelope usually accounts for most of the mass in a classic bomb. So if we now compare the pure explosive device loading, an aerosol bomb can even be five to ten times more effective than a "normal" aircraft bomb. So the difference is colossal, bearing in mind that this result can be achieved at relatively low cost and in a relatively simple way (while increasing effectiveness by increasing accuracy would certainly have been enormously more expensive).

The aerosol bomb has another "interesting" property: since the explosion occurs in a large volume, a phenomenon appears that has no equivalent in the explosion of explosives. The expanding bubble of gas creates a zone of negative pressure at the center as it expands—after expansion, a species occurs

Implosion. This phenomenon was responsible for the trickles of blood from the mouths of the killed Vietnamese - the blood from burst air sacs in the lungs had been sucked out by the "implosion".

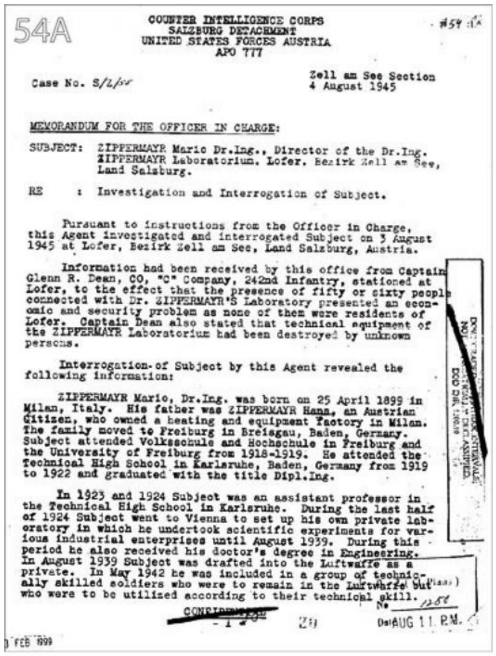
In short, this is an extremely dangerous weapon. An unusual incident from the Second Gulf War, which took place in 1991, may serve as a very good example of their potential use. One of the British Reconnaissance Teams (SAS) in Iraq observed the explosion of an aerosol bomb from a distance and inevitably interpreted it as the explosion of a small nuclear device. The report forwarded to HQ caused a great deal of confusion: it was taken quite seriously, since SAS squads are meticulously trained to recognize various weapons by the nature of their effects and therefore no one expected such a "blunder" from them.

However, this description says a lot about the capabilities of this weapon. Without much exaggeration, the aerosol bomb can be described as an "intermediate link" between classic ammunition and low-capacity nuclear explosive devices.

As it turns out, during World War II they worked too
Germans on such a gun ...

This work was carried out under the alias *Hexenkessel .*
The laboratory for ballistic research in the Berlin district of Gatow, the laboratory of a certain Dr. Zippermayr and the company Dynamit AG Krümel. However, the Germans did not use volatile hydrocarbons for this purpose, but fine coal dust.
This material is more demanding, but is characterized by similar effectiveness. Some information on this topic is provided by current research on coal dust explosions in mines: an explosive mixture is already formed by millimeter-sized grains of coal if their "concentration" exceeds twelve percent of the air mass. The approximate explosion limit is 45 to 1,000 g of dust in one cubic meter of air. The strongest explosion occurs when there is 300-500 g of coal grains in one cubic meter of air.
51 Certain data on the *Hexenkessel* project could be obtained from access to the files of the aforementioned Dr. Ing. Zippermayr. In August 1945 he was appointed by an agency of the American

Interrogated counterintelligence in Austria. The essential information about the work in which he was involved can be found in the interrogation protocol (Document 54). Here is an excerpt that refers to this work:



54A

COUNTER INTELLIGENCE CORPS
SALZBURG DETACHMENT
UNITED STATES FORCES AUSTRIA
APO 777

#54

Case No. S/Z/58

Zell am See Section
4 August 1945

MEMORANDUM FOR THE OFFICER IN CHARGE:

SUBJECT: ZIPPERMAYR Mario Dr.Ing., Director of the Dr.Ing. ZIPPERMAYR Laboratorium, Lofer, Bezirk Zell am See, Land Salzburg.

RE : Investigation and Interrogation of Subject.

Pursuant to instructions from the Officer in Charge, this Agent investigated and interrogated Subject on 3 August 1945 at Lofer, Bezirk Zell am See, Land Salzburg, Austria.

Information had been received by this office from Captain Glenn R. Dean, CO, "C" Company, 242nd Infantry, stationed at Lofer, to the effect that the presence of fifty or sixty people connected with Dr. ZIPPERMAYR'S Laboratory presented an economic and security problem as none of them were residents of Lofer. Captain Dean also stated that technical equipment of the ZIPPERMAYR Laboratorium had been destroyed by unknown persons.

Interrogation of Subject by this Agent revealed the following information:

ZIPPERMAYR Mario, Dr.Ing. was born on 25 April 1899 in Milan, Italy. His father was ZIPPERMAYR Hans, an Austrian Citizen, who owned a heating and equipment factory in Milan. The family moved to Freiburg in Breisgau, Baden, Germany. Subject attended Volksschule and Hochschule in Freiburg and the University of Freiburg from 1918-1919. He attended the Technical High School in Karlsruhe, Baden, Germany from 1919 to 1922 and graduated with the title Dipl.Ing.

In 1923 and 1924 Subject was an assistant professor in the Technical High School in Karlsruhe. During the last half of 1924 Subject went to Vienna to set up his own private laboratory in which he undertook scientific experiments for various industrial enterprises until August 1939. During this period he also received his doctor's degree in Engineering. In August 1939 Subject was drafted into the Luftwaffe as a private. In May 1942 he was included in a group of technically skilled soldiers who were to remain in the Luftwaffe but who were to be utilized according to their technical skill.

No. 1256

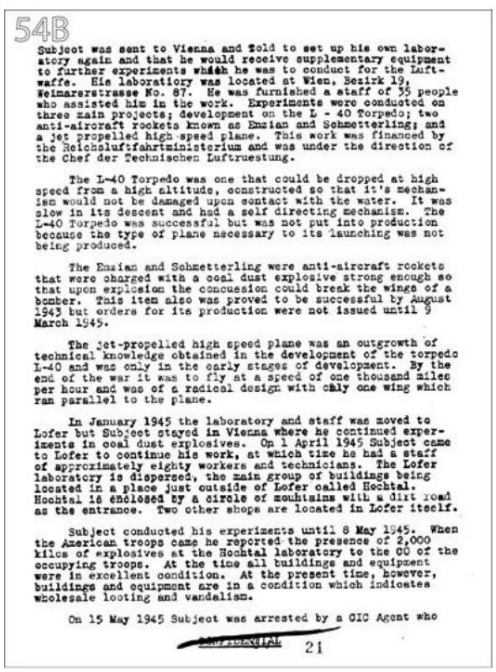
~~CONFIDENTIAL~~

- 1 -

20

Date AUG 11 P.M.

FEB 1999



54B

Subject was sent to Vienna and told to set up his own laboratory again and that he would receive supplementary equipment to further experiments which he was to conduct for the Luftwaffe. His laboratiory was located at Wien, Bezirk 19, Weimarerstrasse No. 87. He was furnished a staff of 35 people who assisted him in the work. Experiments were conducted on three main projects; development on the L - 40 Torpedo; two anti-aircraft rockets known as Enzian and Schmetterling; and a jet propelled high speed plane. This work was financed by the Reichsluftfahrtministerium and was under the direction of the Chef der Technischen Luftruestung.

The L-40 Torpedo was one that could be dropped at high speed from a high altitude, constructed so that it's mechanism would not be damaged upon contact with the water. It was slow in its descent and had a self directing mechanism. The L-40 Torpedo was successful but was not put into production because the type of plane necessary to its launching was not being produced.

The Enzian and Schmetterling were anti-aircraft rockets that were charged with a coal dust explosive strong enough so that upon explosion the concussion could break the wings of a bomber. This item also was proved to be successful by August 1943 but orders for its production were not issued until 9 March 1945.

The jet-propelled high speed plane was an outgrowth of technical knowledge obtained in the development of the torpedo L-40 and was only in the early stages of development. By the end of the war it was to fly at a speed of one thousand miles per hour and was of a radical design with only one wing which ran parallel to the plane.

In January 1945 the laboratory and staff was moved to Lofer but Subject stayed in Vienna where he continued experiments in coal dust explosives. On 1 April 1945 Subject came to Lofer to continue his work, at which time he had a staff of approximately eighty workers and technicians. The Lofer laboratory is dispersed, the main group of buildings being located in a place just outside of Lofer called Hochtal. Hochtal is enclosed by a circle of mountains with a dirt road as the entrance. Two other shops are located in Lofer itself.

Subject conducted his experiments until 8 May 1945. When the American troops came he reported the presence of 2,000 kilos of explosives at the Hochtal laboratory to the CO of the occupying troops. At the time all buildings and equipment were in excellent condition. At the present time, however, buildings and equipment are in a condition which indicates wholesale looting and vandalism.

On 15 May 1945 Subject was arrested by a CIC Agent who

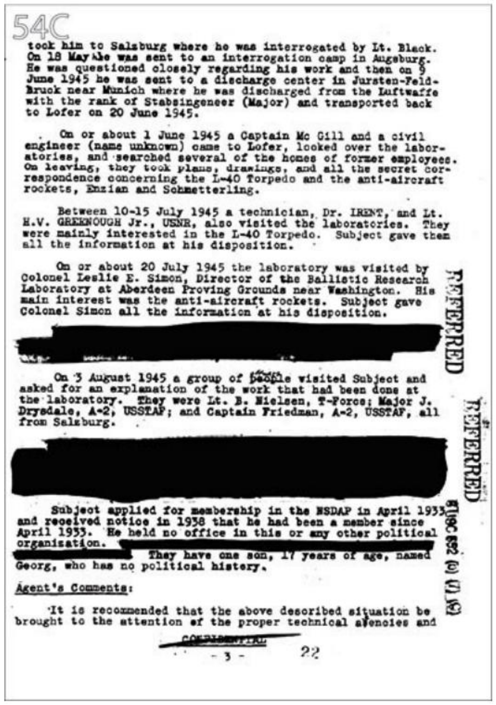
~~CONFIDENTIAL~~ 21

"In the years 1923 and 1924 the interrogated man (Mario Zippermayr) Assistant professor at the Technical University in Karlsruhe. In the

In the second half of 1924, Zippermayr went to Vienna, where he founded his own private laboratory and carried out scientific investigations for various industrial companies there until August 1939. It was also around this time that he received his PhD in Engineering. In August 1939, Zippermayr was drafted into service in the Luftwaffe as a private. In May 1942 he was assigned to a group of technically gifted soldiers who would remain with the Luftwaffe but be deployed according to their technical ability.

Zippermayr was then sent back to Vienna with instructions to rebuild his laboratory for investigations commissioned by the Luftwaffe. For this he should receive additional equipment. This laboratory was located in Vienna in District 19, at Weimarer Strasse 87. In this context, he received the appropriate staff – 35 people who supported him in his work. Trials were conducted as part of three main projects: the development of the L-40 torpedo; two anti-aircraft missiles, known as the *Gentian* and the *Butterfly;* and a high-speed jet aircraft.

This became Financed by the Reich Aviation Ministry through and headed by the chief of technical air armament. The L-40 torpedo should be capable of being released from a high-speed, high-altitude aircraft, and its mechanism should be able to withstand impact with the water surface. He slowly descended, maintaining the given direction with the help of a navigation system. Trials of the L-40 torpedo were successful, but it did not go into production because no aircraft suitable for its transport was made.



54C

took him to Salzburg where he was interrogated by Lt. Black. On 18 May he was sent to an interrogation camp in Augsburg. He was questioned closely regarding his work and then on 9 June 1945 he was sent to a discharge center in Jursten-Feld-Bruck near Munich where he was discharged from the Luftwaffe with the rank of Stabsingeneer (Major) and transported back to Lofer on 20 June 1945.

On or about 1 June 1945 a Captain Mc Gill and a civil engineer (name unknown) came to Lofer, looked over the laboratories, and searched several of the homes of former employees. On leaving, they took plans, drawings, and all the secret correspondence concerning the L-40 Torpedo and the anti-aircraft rockets, Enzian and Schmetterling.

Between 10-15 July 1945 a technician, Dr. IRENT, and Lt. H.V. GREENOUGH Jr., USNR, also visited the laboratories. They were mainly interested in the L-40 Torpedo. Subject gave them all the information at his disposition.

On or about 20 July 1945 the laboratory was visited by Colonel Leslie E. Simon, Director of the Ballistic Research Laboratory at Aberdeen Proving Grounds near Washington. His main interest was the anti-aircraft rockets. Subject gave Colonel Simon all the information at his disposition.

[redacted]

On 3 August 1945 a group of people visited Subject and asked for an explanation of the work that had been done at the laboratory. They were Lt. B. Nielsen, T-Force; Major J. Drysdale, A-2, USSTAF; and Captain Friedman, A-2, USSTAF, all from Salzburg.

[redacted]

Subject applied for membership in the NSDAP in April 1933 and received notice in 1938 that he had been a member since April 1933. He held no office in this or any other political organization. [redacted] They have one son, 17 years of age, named Georg, who has no political history.

Agent's Comments:

It is recommended that the above described situation be brought to the attention of the proper technical agencies and

~~CONFIDENTIAL~~

- 3 - 22

REFERRED

REFERRED

5 USC 552 (c) (7) (C)

54D

~~CONFIDENTIAL~~

and that in the event that the personnel of Dr. ZIPPERMAYR'S Laboratory are not to be utilized in any way [redacted]

It is also recommended that the proper technical agency remove from Dr. ZIPPERMAYR and his associates any other plans, sketches, models and data connected with his former experiments. It is the opinion of this Agent that Dr. ZIPPERMAYRS experiments are of value and that all informations concerning them be controlled; that a check be made if possible of Captain McGill to ascertain whether he had the proper authority to remove the plans of the L-40 and the anti-aircraft rockets and whether or not he has turned them over to the proper agency.

[redacted]

Special Agent, CIC

Approved: [redacted]

W.J. Kaufmann, Jr.
Major, MI

Distribution:

2 - G-2 (CI) USFA.
1 - G-2 II Corps, USFA.
1 - G-2 42nd Infantry Division.
1 - File

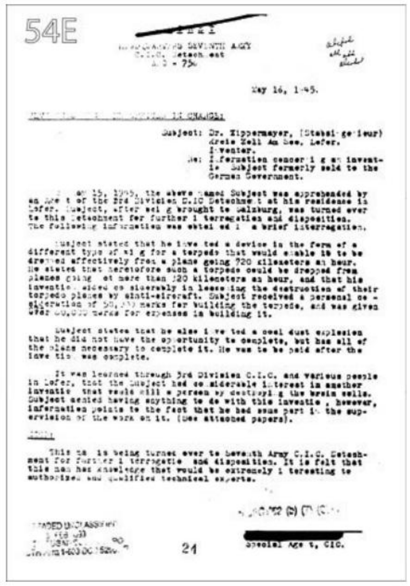
Enzian and *Schmetterling* were anti-aircraft missiles that had warheads armed with coal dust. Their explosive power was so great that they could rip off the wings of an attacked bomber. These rockets were also successfully tested in August 1943, but the order to start production was not issued until March 9, 1945.

The high-speed jet aircraft was designed based on the technical knowledge gained during the development of the L-40 torpedo and was in an early stage of development. At the end of the war there should be one

> Complete flight at a speed of 1,000 miles per hour (1,609 km/h). It was a no-compromise design with a single wing running parallel to the plane [to the fuselage? – note d.
> author] passed.
>
> In January 1945, the laboratory and staff were moved to Lofer, but Zippermayr remained in Vienna, where he continued his experiments with aerosol bombs based on coal dust. To continue his work, Zippermayr came to Lofer on April 1st, where he had a staff of 80 workers and technicians. The laboratory in Lofer is scattered, the main buildings are located just outside the town in a place called Hochtal. It is a valley surrounded by mountains, to which a dirt road leads. Two other workshops are located in Lofer itself.
>
> Zippermayr carried out his tests until May 8, 1945. When the American occupation troops arrived, he reported to their commander that 2,000 kg of explosives were stored in the labs in Hochtal. At that time all the buildings and equipment were in excellent condition; today the complex is evidence of mass looting and vandalism.
>
> On May 15, 1945, Zippermayr was arrested by a CIC (Military Intelligence) agent who took him to Salzburg, where he was interrogated by Lieutenant Black."

The American documents indicate that the work of this person was by no means limited to the above-mentioned questions, although he himself was not willing to admit this (it cannot be ruled out that the reason for this was human experimentation). Here is an excerpt from Document 58 that contains information on this:

> "With the help of the 3rd Division of the CIC and with the participation of various people in Lofer, it was determined that Zippermayr had been very interested in another invention for killing people by destroying their brain cells. Zippermayr denied having anything to do with this discovery, although information suggests he had a hand in directing this work."



54E

HEADQUARTERS SEVENTH ARMY
C.I.C. Detachment
A.P.O. 758

May 16, 1945.

Subject: Dr. Zippermayer, (Stabsingenieur)
Kreis Zell Am See, Lofer.
Inventor.
Re: Information concerning an invention Subject formerly sold to the German Government.

On 15, 1945, the above named Subject was apprehended by an Agent of the 3rd Division C.I.C Detachment at his residence in Lofer. Subject, after being brought to Salzburg, was turned over to this Detachment for further interrogation and disposition. The following information was obtained in a brief interrogation.

Subject stated that he invented a device in the form of a different type of wing for a torpedo that would enable it to be dropped effectively from a plane going 720 kilometers an hour. He stated that heretofore such a torpedo could be dropped from planes going at more than 320 kilometers an hour, and that his invention aided considerably in lessening the destruction of their torpedo planes by anti-aircraft. Subject received a personal consideration of 50,000 marks for building the torpedo, and was given over 60,000 marks for expenses in building it.

Subject states that he also invented a coal dust explosion that he did not have the opportunity to complete, but has all of the plans necessary to complete it. He was to be paid after the invention was complete.

It was learned through 3rd Division C.I.C. and various people in Lofer, that the Subject had considerable interest in another invention that would kill a person by destroying the brain cells. Subject denied having anything to do with this invention, however, information points to the fact that he had some part in the supervision of the work on it. (See attached papers).

This man is being turned over to Seventh Army C.I.C. Detachment for further interrogation and disposition. It is felt that this man has knowledge that would be extremely interesting to authorized and qualified technical experts.

[redacted]
Special Agent, CIC.

24

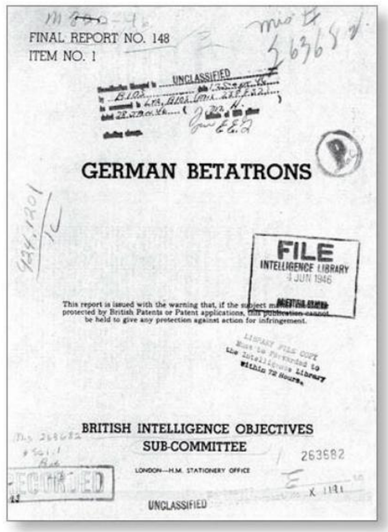
So here we have another mystery that has so far escaped the attention of researchers studying the history of World War II. Perhaps this riddle can also be solved at some point.

I found many documents on the subject of "death rays" in American archives in the years 2000-2001, especially among the material relating to the so-called "ALSOS mission", which immediately after the war the German nuclear program and the related standing questions should be clarified. 52 The "death rays" are also mentioned in the British intelligence analysis devoted to particle accelerators, specifically the so-called betatrons. 53 With their help, a high-energy directed X-ray beam could be generated. The British report states: 53

> "The Air Force authorized the work in hopes of using death rays to engage enemy aircraft."

The documents of the ALSOS mission again show that the betatron was seen as the starting point for the construction of a weapon system. Many research groups were commissioned with the realization of this task, the most important being the group around Dr. Wideröe and the company BBC from Mannheim. Wideröe gives the impression of being a very active and imaginative scientist. By September 1943 alone, his research had resulted in at least ten patent applications.

The latest available report from Dr. Wideröe on the progress of work from September 15, 1944 suggests that there were still about four months to complete a "weapon". It should be an accelerator using electrical discharges with a voltage of 200 MV (million volts).


FINAL REPORT NO. 148
ITEM NO. 1

UNCLASSIFIED

GERMAN BETATRONS

FILE
INTELLIGENCE LIBRARY
4 JUN 1946

This report is issued with the warning that, if the subject matter should be protected by British Patents or Patent applications, this publication cannot be held to give any protection against action for infringement.

BRITISH INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

LONDON—H.M. STATIONERY OFFICE

263582

RECORDED

UNCLASSIFIED

A German document from the files of the "ALSOS Mission" with a brief description of the "death ray project" that was connected to Großostheim.

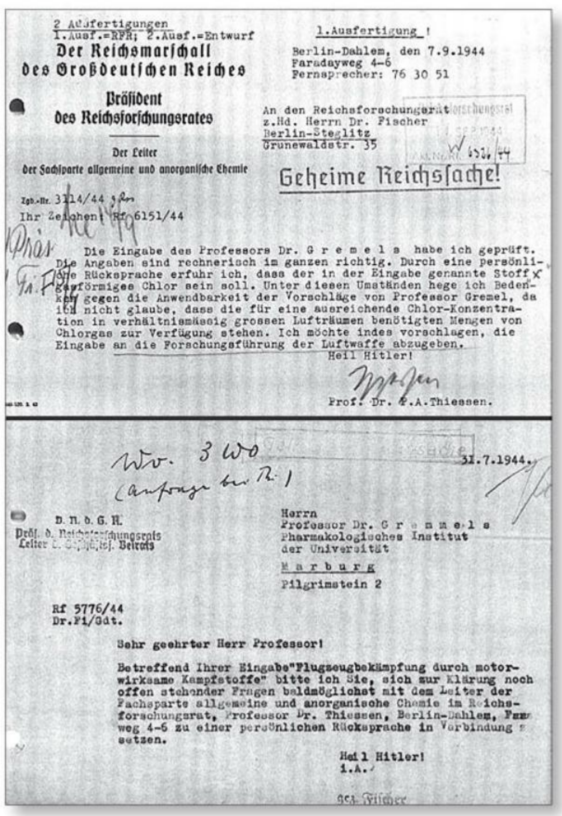

Kurzer Bericht über die Arbeiten, welche vom Unterzeichneten und seinen Mitarbeitern im Institut für röntgenologische Roh- und Werkstofforschung im Rahmen des Forschungsauftrages DE 6224/0109/43 seit 20. April 1943 durchgeführt wurden.

1. Ausarbeitung der Grundlagen des Projektes für die Besprechung mit dem Herrn Generalfeldmarschall am 20.4.43.
2. Verschiedene Denkschriften und Berichte an GL/St mit Einzelheiten meiner Planung und Vorschläge für die Durchführung.
3. Mitarbeit bei den technischen und organisatorischen Vorarbeiten über die Auswahl des Platzes und der Einrichtung der Versuchsstelle Groß Ostheim.
4. Exposé über die Bedeutung des Wideröeschen Strahlentransformators für die vorliegenden Pläne und maßgebende Beteiligung an Verhandlungen mit Herrn Dr. Wideröe.
5. Ausarbeitung der Pläne betr. Auf- und Ausbau der großen Halle in Gr. Ostheim, gemeinsam mit dem Büro Prof. Tamms (Arch. Sander) und den zuständigen Herren vom Luftgau XII.
6. Aufstellung der Pläne für Installation, Telefonanlage usw. für die zunächst vorgesehenen Laboratoriumsbaracken und den Ausbau der Unterkunftsräume.
7. Versuch zur Einrichtung wissenschaftlicher Arbeitsräume nebst Feinmechanikerwerkstatt, zunächst mit dem Inventar des Instituts für röntgenologische Roh- und Werkstofforschung zum Zwecke der Vornahme dringlicher Vorversuche. Diese Einrichtungen wurden auf Veranlassung der Forschungsführung inzwischen wieder aus Ostheim entfernt.
8. Schulung der aus der Truppe herausgezogenen wissenschaftlichen und ingenieurtechnischen Mitarbeiter.
9. Zusammenstellung der für die Arbeiten wichtigen Literatur und Ausarbeitung eines zusammenfassenden kritischen Berichtes über die bisherigen Ergebnisse ~~auch~~ auf dem Gebiete der Physik durchdringender Röntgen- und Gammastrahlen, sowie Elektronen.
10. Aufstellung von Inventarlisten und Geräten für die erste Einrichtung von Laboratorien und Werkstätten.
11. Beschaffung der 1,2 Mill.Voltanlage vom Hamburger Staat.
12. Bestellung einer 2,2 MV-Röntgenanlage bei der Fa. C.H.F.Müller in Hamburg.
13. Entwicklungsauftrag an die Firma C.H.F.Müller-Hamburg über einen 15 MV-Strahlentransformator Bauart Wideröe..
14. Beschaffung von Laboratoriumsbedarf und Geräten aus Beutestellen der Luftwaffe.
15. Wissenschaftliche Arbeit theoretischer Natur über die Ausbreitung und Schwächung harter Röntgenstrahlen in Luft variabler Zusammensetzung, Dichte und Temperatur für verschieden hohe Primärenergien
16. Projektierung einer Großanodenröntgenröhre nach eigenen Vorschlägen.
17. Projektierung einer Anlage zur Erzeugung hoher Spannung und großer Stromstärke nach dem Kaskadenprinzip auf Grund eines eigenen DRP.

Leipzig, den 4. Mai 1944.

Prof.Dr.E.Schiebold.

The report from May 1944 by Prof. Dr. E. Schiebold, the head of the Luftwaffe research laboratory, which was also entrusted with this task, indicates a similar progress in the work. 52 It mentions, among other things, the use of Luftwaffe resources, the construction of a "big hall" for research purposes on the laboratory complex in Großostheim and the training of specialists who were released from the military.
One might get the impression that the whole thing has not progressed beyond the experimental stage, but the data are largely incomplete - they break off at one point and obviously do not cover the whole complex of questions. For example, there is nothing about the work of the previously mentioned company GEMA. In addition, the large number of people and institutions involved gives food for thought. Against this background, it seems strange that this topic is simply ignored in current treatises.


2 Ausfertigungen
1.Ausf.=RFR; 2.Ausf.=Entwurf

1.Ausfertigung !

Der Reichsmarschall
des Großdeutschen Reiches

Präsident
des Reichsforschungsrates

Der Leiter
der Fachsparte allgemeine und anorganische Chemie

Berlin-Dahlem, den 7.9.1944
Faradayweg 4-6
Fernsprecher: 76 30 51

An den Reichsforschungsrat
z.Hd. Herrn Dr. Fischer
Berlin-Steglitz
Grunewaldstr. 35

Geheime Reichssache!

Tgb.-Nr. 3114/44
Ihr Zeichen: Rf 6151/44

Die Eingabe des Professors Dr. G r e m e l s habe ich geprüft. Die Angaben sind rechnerisch im ganzen richtig. Durch eine persönliche Rücksprache erfuhr ich, dass der in der Eingabe genannte Stoff gasförmiges Chlor sein soll. Unter diesen Umständen hege ich Bedenken gegen die Anwendbarkeit der Vorschläge von Professor Gremel, da ich nicht glaube, dass die für eine ausreichende Chlor-Konzentration in verhältnismässig grossen Lufträumen benötigten Mengen von Chlorgas zur Verfügung stehen. Ich möchte indes vorschlagen, die Eingabe an die Forschungsführung der Luftwaffe abzugeben.

Heil Hitler!
Prof. Dr. P.A.Thiessen.

Wv. 3 Wo
(Anfrage bei R.)

31.7.1944.

D. R. d. G. R.
Präs. d. Reichsforschungsrats
Leiter d. Geschäftsf. Beirats

Herrn
Professor Dr. G r e m m e l s
Pharmakologisches Institut
der Universität
M a r b u r g
Pilgrimstein 2

Rf 5776/44
Dr.Fi/Gdt.

Sehr geehrter Herr Professor!

Betreffend Ihrer Eingabe "Flugzeugbekämpfung durch motorwirksame Kampfstoffe" bitte ich Sie, sich zur Klärung noch offen stehender Fragen baldmöglichst mit dem Leiter der Fachsparte allgemeine und anorganische Chemie im Reichsforschungsrat, Professor Dr. Thiessen, Berlin-Dahlem, Faradayweg 4-6 zu einer persönlichen Rücksprache in Verbindung zu setzen.

Heil Hitler!
i.A.
gez. Fischer

Two documents from the Reich Research Council on chemical agents that could paralyze the engines of Allied bombers. (from the documents of the "ALSOS Mission").

This is all the more striking when we know that in the files of the Personal Staff of the Reichsfuhrer SS there was a special folder containing correspondence about a "weapon" that used directed energy to combat enemy aircraft (these documents 54 also here we find traces of the ones that came involved in the whole thing. This folder contains, among other things, letters into my hands in 2001). highest circles from the companies ELEMAG and AEG as well as the Reich Research Council. However, it is not clear from them whether there was any practical application. Werner Osenberg, who stated on February 7, 1945 that the work had not brought any concrete results, although it had been carried out "for several decades".

The opinion of the authorized representative for high-frequency research, which should be decisive in this matter, would also be interesting in this context. A document from January 1945 contains such a statement.

[54] From this it emerges that due to the “great burden” on the research institutions subordinate to the authorized representative, they are not in a position to devote themselves to this complex of questions.

So I could not find any clear confirmation in the German sources for the combat use of directed energy beams, although the number of institutions that appear in this context is surprising and does not particularly fit a project without practical relevance.

Speaking of “electromagnetic weapons”, another project should be mentioned, which incidentally was also aimed at Allied bombers.

Among the hundreds, if not thousands, of reports from Allied secret services about "new weapons" of the Third Reich, many referred to revolutionary or simply unusual concepts in the field of artillery armament. Sometimes these reports contained errors or exaggerated assessments that made the new German solutions seem more sinister than they really were. Here is an example - a description that appears in Document 4 of December 29, 1943:

"According to reports from France, which are based on information

Based on industry circles, the new German weapon is a long-range heavy cannon. It fires projectiles containing phosphorus and other chemical substances that deplete the oxygen in the atmosphere within hundreds of meters of the impact site, creating deadly conditions for all living organisms."

The Germans were, of course, actually working on a long-range heavy gun, but a shell fired from it would certainly not have the effect described. The sheer flood of similar, highly contradictory reports meant that a certain subset of them did not receive proper attention. These documents contained similarly unusual details, but related to a weapon that it was only after the war that it could be said with certainty that the Germans had actually worked intensively on it (this fact is not widely known to this day).

It is about the "electromagnetic cannon" - a weapon in which the projectile is not accelerated by gases generated by the burning powder charge, but by an extremely strong magnetic field that is maintained for a split second. The principle of operation of the electromagnetic cannon is relatively simple - it works in a similar way to an electric linear motor, however, the technological requirements for the construction of a full-fledged device are so high that even –; today such a weapon is considered forward-looking, precisely because it eliminates many technical barriers could be overcome, which are insurmountable in the case of a classic cannon. Such a

The fundamental obstacle that engineers and the military dream of overcoming is the muzzle velocity of the bullet – a key parameter on which the penetration of core bullets (the basic form of armor-piercing ammunition) depends. No modern tank fires shells with an initial speed of more than 2,000 m/s.

Exceeding this "magical" limit on the basis of classic solutions would be extremely difficult and would entail costs that would be disproportionate to the effect that could be achieved. Above all, this would result in a drastic reduction in barrel life - probably only 100-200 shots would be possible (the life

of the barrels of modern 120-125mm caliber tank guns is about 500-1,000 shots, bearing in mind that such a barrel costs on average tens of thousands of dollars). New solutions would also be required in the area of the powder charge itself - the powder would probably need to be replaced with a completely different material, one with a correspondingly higher burning rate and energy, which in turn would increase the risk of such a material exploding (thereby causing not only the gun, but the whole tanks could be destroyed). The pipe tear strength limit is also difficult to overcome – it is precisely defined. The strength of steel cannot be significantly increased, and "thickening" the tube does very little - its inner layers would still burst. Due to tactical requirements, the tube length itself is also limited.

The problem presented above can also be summed up in a much simpler way: It is common knowledge that the design of classic barrel weapons has not changed significantly since the end of the Second World War. The infantry's basic modern weapon, the automatic rifle (a self-loader for so-called intermediate cartridges), does not differ significantly from the first design of this type, the MP-43 from 1943 Today, the basic machine gun of the Wehrmacht - the MG-42 (currently MG-3) is produced without major modifications for the needs of the Bundeswehr and at least ten other armies.

With the passage of time and the further development of the other types of armament, the need to discard the classic barrel weapons, which, as you can see, had basically reached their limits half a century ago, grew ever stronger. This need is accompanied by increasing efforts in the search for analogous but qualitatively completely new solutions.

Although such solutions have been sought for quite some time, I am convinced that the vast majority of specialists, when asked about the best future-oriented "successor" of the classic cannon, would unequivocally name the electromagnetic cannon.

Paradoxically, the 63 years that have passed since the war research described was interrupted did not mean that it lost its topicality. On the contrary – this period of time

dictates that they be looked at with particular attention, as they continue to be a source of inspiration.

So let's go back to the wartime sources. The available ...

data clearly shows that the Germans had no intention of using the new armament in their tanks - they simply lacked a power source of the appropriate power to be installed in the tank. So it was only a stationary weapon in question.

The electromagnetic cannon was therefore attractive to the leadership of the Third Reich for a simple reason: it was the only launcher weapon that could have been an effective alternative to the V1 guided rocket and the (particularly expensive) V2 rocket (especially given the problems with the unrealistic concept of the V3 gun). One must not forget that a similar potential was invested in the development, production and use of the V1 and V2 as in the United States in the development of the atomic bomb - the "Manhattan Project" had assumed mythical proportions there. A competitive solution in this area therefore opened up access to enormous funds, which one could not obtain today for such a goal. Regardless of the mentioned advantages of the "electromagnetic cannon"., it must be taken into account that the high flight speed of the

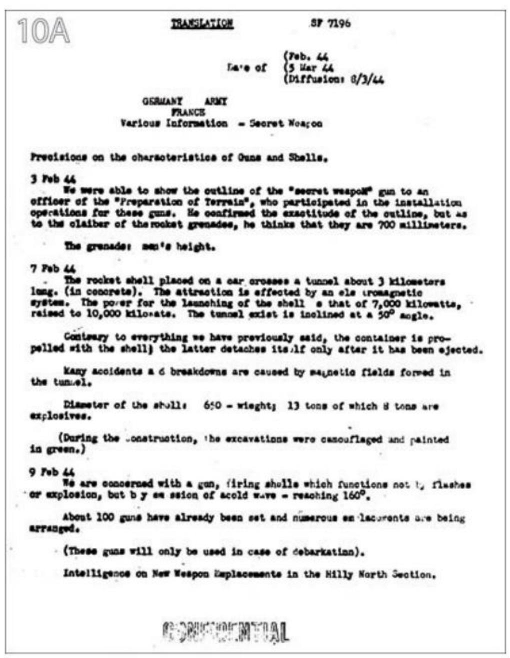
missiles not only means a long range, but also results in high targeting accuracy - especially with moving targets, since shortening the projectile flight time is key here. It is precisely these factors that probably ensured that the new German solution was also used in anti-aircraft defense. But that only became apparent after the war.

Another intelligence document, this time dated March 30, 1944, contains only information about the electromagnetic “supercannon”: “New launcher device: It consists of selenoid [a magnetic coil – ed.

authors] with a length of about 900-1,000 meters buried at a shallow angle on the edge of the Cotentin district. The selenoid coil is connected to a high-voltage cable with a transmission capacity of 10,000 kilowatts (10 MW), which

was moved by the CCM." A slightly earlier report – dated March 5, 1944, but based on information from February (Document 10) – contains much more information. The projectiles are therefore equipped with an additional rocket engine (the mass of which accounts for a small part of the projectile mass). This is interesting information that has its parallel in current research; however, it requires an explanation: in the case of projectiles with a very high flight speed, such a drive can decisively affect the range, even if (paradoxically!) it does not provide much thrust. This is a physical effect based on the fact that under the conditions described, a large part of the aerodynamic drag is due to the vacuum that is created directly behind the flying projectile. An additional rocket engine (or even a larger set of tracers) fills this vacuum with combustion gases in addition to its basic function.

Here is the translation of this very interesting document:



10A

TRANSLATION SF 7196

Date of (Feb. 44 (5 Mar 44 (Diffusion: 8/3/44

GERMANY ARMY
FRANCE
Various Information - Secret Weapon

Precisions on the characteristics of Guns and Shells.

3 Feb 44
We were able to show the outline of the "secret weapon" gun to an officer of the "Preparation of Terrain", who participated in the installation operations for these guns. He confirmed the exactitude of the outline, but as to the claiber of the rocket grenades, he thinks that they are 700 millimeters.

The grenade: men's height.

7 Feb 44
The rocket shell placed on a car crosses a tunnel about 3 kilometers long. (in concrete). The attraction is effected by an ele tromagnetic system. The power for the launching of the shell e that of 7,000 kilowatts, raised to 10,000 kilowats. The tunnel exist is inclined at a 50° angle.

Contrary to everything we have previously said, the container is propelled with the shell; the latter detaches itself only after it has been ejected.

Many accidents a d breakdowns are caused by magnetic fields formed in the tunnel.

Diameter of the shell: 650 - wieght; 13 tons of which 8 tons are explosives.

(During the construction, the excavations were camouflaged and painted in green.)

9 Feb 44
We are concerned with a gun, firing shells which functions not by flashes or explosion, but b y em ssion of acold wave - reaching 160°.

About 100 guns have already been set and numerous em lacements are being arranged.

(These guns will only be used in case of debarkation).

Intelligence on New Weapon Emplacements in the Hilly North Section.

CONFIDENTIAL

"Specification of the characteristics of guns and projectiles:
February 3, 1944

We were able to understand the basics of the 'secret weapon' (a cannon)

to an officer in charge of 'site preparation' who had been involved in setting up these guns. He confirmed that this information is true, however, regarding the caliber of the missile, he said it was 700 mm. The missile is as tall as a man.

February 7, 1944

Each missile travels on a sled through a tunnel clad in concrete that is approximately three kilometers long. An electromagnetic system takes care of its acceleration. The power required to launch the missile is 7,000 kW (7 MW), increasing to 10,000 kW. The mouth of the tunnel is inclined at an angle of 50°.

Contrary to what we had previously stated, the missile together with the container [the so-called shoe - an element that centers the missile in the tube or in the slide - ed. Author's] accelerated. This container is separated from the missile only after launch.

The magnetic fields generated in the tunnel cause numerous accidents and incidents. Missile diameter: 650 [mm], weight – 13 tons, of which 8 tons are explosives.

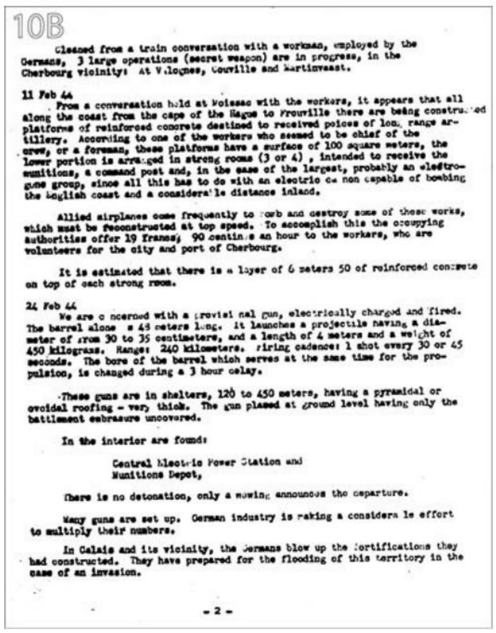
During construction, the earthworks were camouflaged with a green paint. […]

Intelligence material on the location of the new weapons in the mountainous northern zone: According to a conversation with a worker hired by the Germans during a train journey, work is being carried out on three large installations (secret weapons) near Cherbourg: at Valognes, Couville and Martinvaast.

February 11, 1944

Discussions with the workers at Moissac indicate that reinforced concrete platforms are being built all along the coast from Cape Hague to Frouville, having something to do with long-range artillery. According to one of the workers who a

Foreman or foreman, these platforms have an area of about 100 m2 ; underneath are reinforced bunkers (three or four) intended to house ammunition and command posts. The largest of these probably also houses an electroguns group. author] as all this involves an electric cannon capable of shelling the English coast and a large area inland. [...]



10B

Gleaned from a train conversation with a workman, employed by the Germans, 3 large operations (secret weapon) are in progress, in the Cherbourg vicinity: At Valognes, Couville and Martinvast.

11 Feb 44

From a conversation held at Voisenc with the workers, it appears that all along the coast from the cape of the Hague to Frouville there are being constructed platforms of reinforced concrete destined to received peices of long range artillery. According to one of the workers who seemed to be chief of the crew, or a foreman, these platforms have a surface of 100 square meters, the lower portion is arranged in strong rooms (3 or 4) , intended to receive the munitions, a command post and, in the case of the largest, probably an electrogune group, since all this has to do with an electric cannon capable of bombing the English coast and a considerable distance inland.

Allied airplanes come frequently toorb and destroy some of these works, which must be reconstructed at top speed. To accomplish this the occupying authorities offer 19 francs, 90 centimes an hour to the workers, who are volunteers for the city and port of Cherbourg.

It is estimated that there is a layer of 6 meters 50 of reinforced concrete on top of each strong room.

24 Feb 44

We are concerned with a provisional gun, electrically charged and fired. The barrel alone is 48 meters long. It launches a projectile having a diameter of from 30 to 35 centimeters, and a length of 4 meters and a weight of 450 kilograms. Range: 240 kilometers. Firing cadence: 1 shot every 30 or 45 seconds. The bore of the barrel which serves at the same time for the propulsion, is changed during a 3 hour delay.

These guns are in shelters, 120 to 450 meters, having a pyramidal or ovoidal roofing - very thick. The gun placed at ground level having only the battlement embrasure uncovered.

In the interior are found:

Central Electric Power Station and
Munitions Depot,

There is no detonation, only a mowing announces the departure.

Many guns are set up. German industry is making a considerable effort to multiply their numbers.

In Calais and its vicinity, the Germans blow up the fortifications they had constructed. They have prepared for the flooding of this territory in the case of an invasion.

- 2 -

It is estimated that the ceiling of each bunker consists of a 6.5 meter thick layer of reinforced concrete.

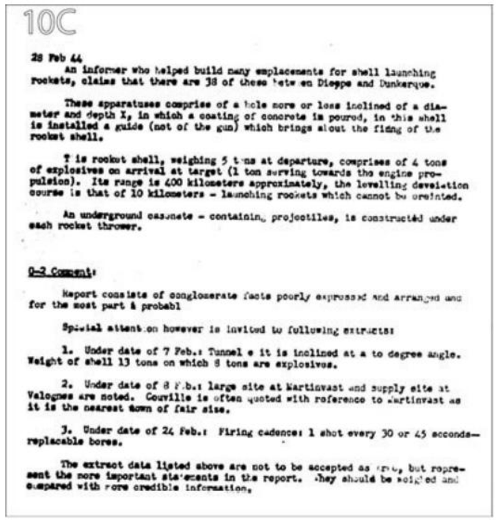
February 24, 1944

We're concerned about the proposed [new] cannon, which is electrically charged and fired. The cannon barrel is 48 meters long. It fires missiles with a diameter of 30 to 35 centimeters, a length of four meters and a mass of 450 kg. Range: 240 km. Rate of fire: one shot every 30-45 seconds. The inner layer of the tube, which also serves to accelerate the missile, is replaced during a three-hour cease-fire. […]

Inside [the bunkers] are the main power plant and an ammunition store.

There is no detonation [at launch], launch is just accompanied by a whirring sound.

Many cannons are brought into position. German industry is doing everything it can to drastically increase their number. [...]"


10C

28 Feb 44

An informer who helped build many emplacements for shell launching rockets, claims that there are 38 of these betw en Dieppe and Dunkerque.

These apparatuses comprise of a hole more or less inclined of a diameter and depth X, in which a coating of concrete is poured, in this shell is installed a guide (not of the gun) which brings about the firing of the rocket shell.

This rocket shell, weighing 5 tons at departure, comprises of 4 tons of explosives on arrival at target (1 ton serving towards the engine propulsion). Its range is 400 kilometers approximately, the levelling deveiation course is that of 10 kilometers - launching rockets which cannot be oreinted.

An underground casemate - containing projectiles, is constructed under each rocket thrower.

G-2 Comment:

Report consists of conglomerate facts poorly expressed and arranged and for the most part & probabl

Special attention however is invited to following extracts:

1. Under date of 7 Feb.: Tunnel e it is inclined at a to degree angle. Weight of shell 13 tons on which 8 tons are explosives.

2. Under date of 8 Feb.: large site at Martinvast and supply site at Valognes are noted. Couville is often quoted with reference to Martinvast as it is the nearest town of fair size.

3. Under date of 24 Feb.: Firing cadence: 1 shot every 30 or 45 seconds—replacable bores.

The extract data listed above are not to be accepted as true, but represent the more important statements in the report. They should be weighed and compared with more credible information.

This document raises more questions than it answers. If the information contained therein can be considered fact at all, what happened to those gigantic guns when the Germans were forced to leave this area? Could such cannons ever have existed?

Their construction would no doubt have been very difficult, but it is resolute to state that they might in fact have existed. Despite its spectacular nature, such a challenge did not exceed the capabilities of the German economy.

If the underground objects (bunkers) built in connection with the cannons had been blown up and camouflaged by the retreating Germans (which would certainly have been the case), it is not at all certain that they would have been discovered and examined later. It is enough to consider the history of German underground industrial facilities, the entrances to which (exits and entrances of communication and installation tunnels) were blown up and camouflaged - such operations could be carried out extremely professionally. For this reason, many such objects have not yet been discovered and, in many cases, have not even been localized. Today there are huge tombs, since those in them

working people (prisoners) were not let out due to a special order from the Reichsfuhrer SS before the blast. Any deviations from this principle were very rare.

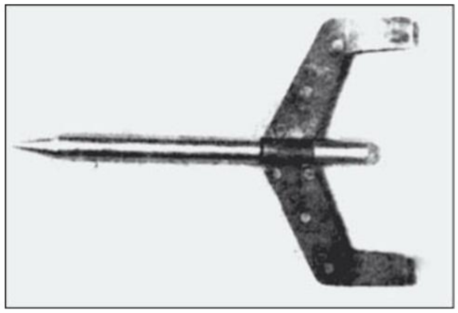
So could it be that the Allies only know part of the truth about the found out about German electromagnetic cannons?

Other data also indicate this: In a special report on the research on the electromagnetic cannon, which was drawn up by a special committee of the American intelligence service at the beginning of 1946, 55 information is also missing that we only know today from other sources. Essentially, the report describes the role played by one particular facility—one of many—in the research into these weapons: the Army Weapons Office Laboratory in Berlin. We now know that the Peenemünde facility played a key role in the mentioned project (incidentally, even its alias remains a secret), because after the war projectiles for an experimental electromagnetic cannon were found there. The work described in this chapter is therefore one of the numerous examples of a complex of questions that we know to exist - but we know with certainty only part of the truth. What exactly does that report contain? It is divided into two main parts: one contains general analyses, the other describes the work on an electromagnetic (relatively small) anti-aircraft gun with a very high rate of fire.

Here are some detailed excerpts from the American report: 55

“Attempts to replace gunpowder with electrical energy are not new. The realization of many concepts was worked on in this laboratory [the Berlin laboratory mentioned above] - ultimately using a method developed by Fauchon-Villiplee during the last war. A major difficulty, of course, is to achieve a sufficiently high power to launch the projectile. The experiments conducted here showed that it was possible to accelerate a body with a mass of twelve grams to 1,100 m/s - in a two meter long tube [a surprisingly good result, comparable to the results of many experiments conducted in the 1980s !

– note d. author], which corresponds to an acceleration 30,000 times higher than the acceleration of gravity. The coupling of two such pipes did not turn out to be particularly successful - a value of 1,200 m/s was reached.



A projectile for an electromagnetic cannon found in Peenemünde

The projectile is accelerated by a 'linear motor' which, in the simplest version, consists of two conductors (rails running parallel to each other) between which the projectile is located, which completes the circuit with the help of its rear fin [such a solution was chosen by the Germans also in the case of the projectile found in Peenemünde - d. author]. When current flows through the circuit, the bullet moves forward. The classical electromagnetic equations apply to this method.

This method was demonstrated to me using the example of an accelerator with a length of 50 cm and projectiles, which will be discussed in this report. After firing, the copper edges of the empennage melted. The bullet's muzzle velocity was low in this demonstration. It is very difficult to find a suitable voltage source. For the experiments, lead-sulfuric acid accumulators with very thin electrodes were used, which delivered an output of 9,000 kW. In addition, capacitors with a capacity of 20,000 microfarads were used, which gave off a voltage of 2,000 V.

Big advantages of an electromagnetic system would be: 1) the possibility to do without a tube, 2) a higher speed than when using powder,

3) higher energy yield than with powder, 4) lower energy costs.

It was planned to start work on a projectile with a diameter of one centimeter and a mass of 60-70 grams and to build an electromagnetic anti-aircraft gun (see attached report) with a caliber of 40 mm. For this purpose, a current of 1,500,000 amperes and a voltage of 1,300 volts would be necessary [i.e. a power of almost two gigawatts! – note d. author]. Three unipolar generators, each weighing 150 tons, were provided for the power supply.

Electrically launched projectiles would need stabilizing fins as they cannot be rotated. This suggests starting with the work in a wind tunnel and at the same time explains the close cooperation of this laboratory with the personnel from Peenemünde who had worked in the wind tunnel in Kochel.

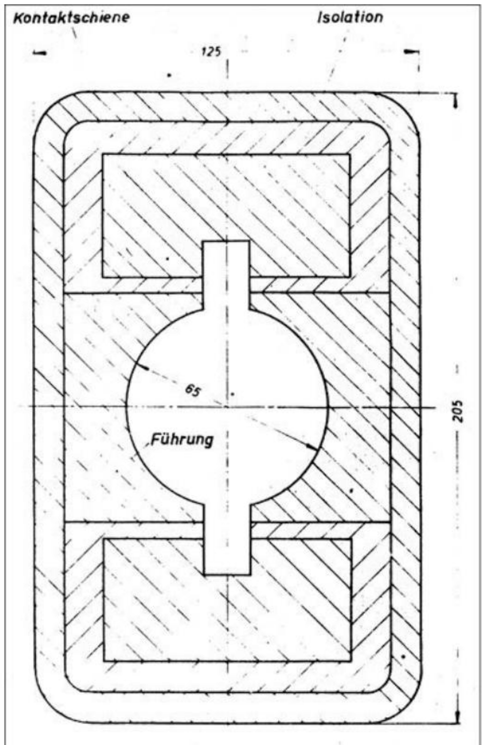
BRIEF DESCRIPTION OF THE ELECTROMAGNETIC ANTI-AIRCRAFT GUN WITH A CALIBER OF 4 CM

I. Introduction

Projectiles fired with the help of powder have a limited speed, which according to van Langweiler can theoretically be 2,810 m/s. He confirmed this value in experiments in which he reached a speed of 2,790 m/s.

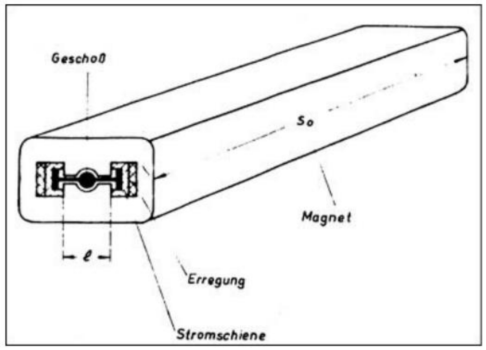
However, such a speed can only be achieved with a certain mass. For heavier objects (bullet) the actual speed is lower and is usually less than 2,000 m/s. In any case, many practical factors prevent the theoretically possible speed from being achieved. The only known method to achieve higher speeds (ie higher accelerations) is based on electrical solutions. Some such solutions have been designed and information on them has been published – mainly in the German patent literature. The most promising solution was worked out by the Frenchman Fauchon-Villiplee; Corresponding models were constructed and examined by the Gesellschaft für Gerätebau. the

Experiments continued all the time and were only interrupted shortly before the end of the war. The above company published the results in the form of reports, the last of which appeared on January 18, 1945.



LM 76
Rohrquerschnitt des eisenlosen Linearmotors

With electrical methods it is not possible to store energy in such a concentrated form as in powder. Therefore, an electromagnetic cannon cannot compete with a conventional cannon in the speed limits that can be achieved by classic launcher systems. Above these limits, however, there are good uses for electromagnetic weapons. These could include anti-aircraft guns, and acceleration (launch) systems for large missiles. long-range artillery



General design draft of a German electromagnetic gun. (via "ALSOS")

Initial considerations for an electromagnetic cannon focused on the possibility of building a long-range cannon that would launch projectiles with a muzzle velocity of 2,000 m/s. However, when V1 and V2 rockets were developed, this idea was discarded or shelved until much higher muzzle velocities could be achieved.

Due to the advances in aviation, which made it possible to increase flight altitude and speed, as well as the inability of conventional anti-aircraft artillery to keep up with this development, the possible use of electromagnetic guns in this area becomes quite real. Increasing the projectile muzzle velocity increases both hit probability and range. Even if they had to be stationary guns, this would not be a significant disadvantage since the majority of today's anti-aircraft artillery used on friendly territory is of the stationary type.

Another possible application of this phenomenon, which has already been realized in the electromagnetic cannon, is launch pads (launching catapults) for large rockets. Due to the sensitivity of their control systems, these missiles cannot handle extreme acceleration and therefore require relatively long ramps to reach the required launch speed within their acceleration limits. The starting ramp can be shorter the more uniform the acceleration is. the

Limiting the 'parameter spread' and the vibrations during the acceleration process makes it possible to get even closer to the targeted load limit. An electromagnetic accelerator can therefore be considered as a competitor to other methods of accelerating large rockets, which have severe limitations.

II. The essence of the problem,

specifications The rapid development of science made it possible to practically approach the issue of electromagnetic projectile acceleration. The Gesellschaft für Gerätebau published on 10. September 1944 the preliminary design of an electromagnetic anti-aircraft gun with a projectile muzzle velocity of 2,000 m/s and an average rate of fire of 6,000 rounds per minute. Based on this draft, talks were held with the heads of the OKL (Air Force High Command), TLR (Technical Air Defense) and Air Defense, as a result of which the following requirements were formulated: A) Muzzle velocity: 2,000 m/s B) Projectile payload: 500 grams [we are talking here about the mass of the explosive; in the next section of the report, the bullet mass is given as 6.5 kg – d. author]

C) The gun is not intended to fire a rapid series of six shots at very high velocity, as originally intended, due to concerns that ramp ('barrel') wear would be too severe. Instead, six guns firing simultaneously should be connected to one power supply.

D) The battery [meaning a battery of six "rails" in the sense of a tactical network - note d. Authors] should fire a salvo of projectiles every five seconds; this results in 6 x 12 = 72 shots/min.

E) As calculations showed, the ramp rails should have a length of ten meters, whereby they should be mounted on a standard anti-aircraft gun carriage due to time constraints. It was

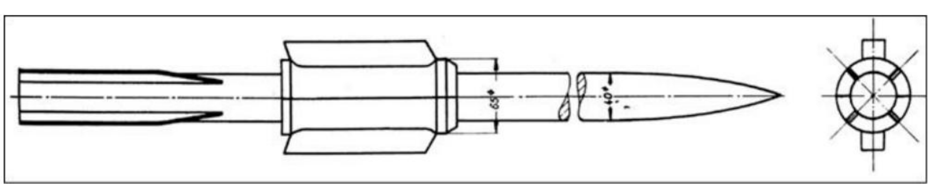
proposed to use a mount for 128 mm caliber anti-aircraft guns.

F) The head of the TLR at the OKL demanded that an experimental air defense system with its own power supply system guns with three rails ("tubes") should be completed in the shortest possible time. […]

V. Reflections on combat use and further development of the cannon [after the war]

Based on the above, it can be concluded that arranging the six guns of a battery on a circle 40 meters in diameter [as originally proposed] would be wrong, especially if they were connected to only one power supply: 1) If this If the system fails, the entire battery also fails.

2) Due to the arrangement in such a small space, the guns - and especially the connections - are not sufficiently protected against air attacks.
3) The cable lengths [of large diameter] required in the above variant between the individual cannons (battery elements) of 20 meters each lead to an excessive consumption of raw materials.
4) When further developing the cannon, the necessary mobility of the entire installation must be taken into account. When connected to a single external power supply, relocation is impossible. It is desirable from the outset to equip each cannon with its own system. This would also allow the weight of the whole installation to be reduced.

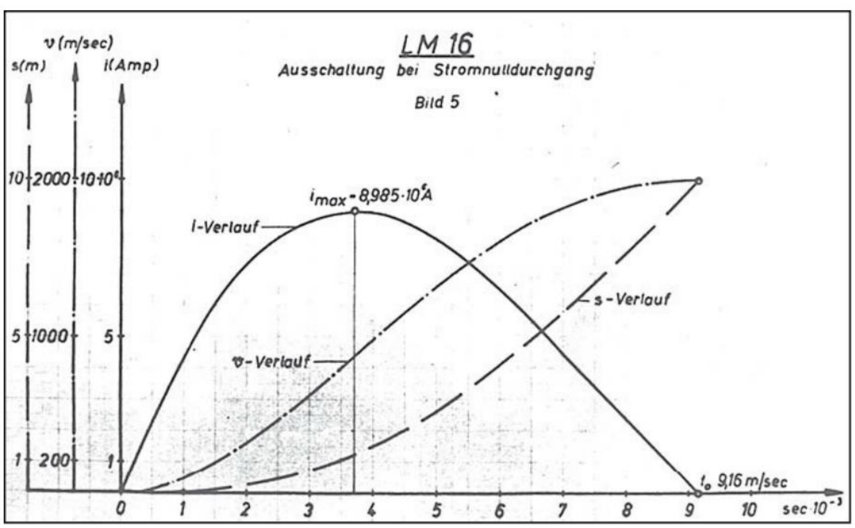


Final version of a projectile for the electromagnetic anti-aircraft gun.

As tests have shown, the drop in speed of the rotor in the power generator after firing six shots is only 4.8%.

Even double the value, i.e. around 10%, would still be unproblematic. This would mean an improvement in energy efficiency by a factor of two and an additional weight reduction of 50%. If each gun had its own generator, it could be scaled down by a factor of six. By combining these two approaches, the weight of the power supply system [i.e. the main problem of system mobility - ed. author] from 450 to 37.5 tons. Newer ones already planned have an angular velocity of the order of 200 m/s. However, it should be easily possible to increase this speed to 300 m/s - especially with unipolar generators - which would more than double the amount of energy produced per unit generator mass. In this way, the power supply systems could be "slimmed" by another 50%.

Verification of these concepts will require further intensive research, which will take several weeks. However, in our opinion, it will be possible to build mobile cannons of this type."



A diagram demonstrating the course of one of the experiments. This shows that the projectile reached a speed of 2,000 m/s. (via "ALSOS")

So much for the American report from 1946 ... A supplement to the information contained therein provide information about in Peenemünde

(according to certain sources also in the village of Schlosskranzbach).

It follows that a modified version of the described anti-aircraft gun with a shortened rail ("tube"), up to eight meters long, was also developed, which was intended for lighter projectiles weighing 2.88 kg. However, a much higher muzzle velocity was achieved, exceeding 2,500 m/s. The estimates formulated in 1944 thus proved to be correct. This gun was fitted with a set of capacitors which, in a brief impulse, delivered an almost gigantic current of three million amperes. The condensers in turn were fed by a power generator driven by two turbine engines. Finally I found an original German report about this work. In terms of content, it agrees with the American elaboration (or rather the translation). However, it contains original technical the documents of the ALSOS mission[52] drawings - including those showing the final version of the 40mm ammunition. These plans have been printed on the preceding pages. Even a cursory glance at it gives an idea of why work was being done on it in Peenemünde. The projectile is a miniature version of the projectile for the V3 cannon, which was tested on the neighboring island. Perhaps the electromagnetic gun was intended as one of the alternatives for a multi-chamber gun?

The unknown face of armored vehicles

The armed vehicles of the Third Reich are seldom described as an area where major breakthroughs were made. But that was definitely the case, even if it relates more to the final phase of the war.

The projects that were created at this time are sometimes more reminiscent of the development status of the 1960s or even 1970s and less of the 1940s. They very significantly surpassed comparable achievements of other countries, although this fact is very little known.

At the beginning of this chapter I quote verbatim one of the American intelligence analyzes of 1945, because it contains very interesting comments on the tendencies in tank building emerging in the last months of the war.

Information on this is extremely rare - this period, in which the Third Reich was already falling, is of immense importance, as it simply anticipated developments that were often to become reality in the field of armored vehicles after the war, many decades later!

Here is the quote: [56]

> “Even in 1945, the firepower of German tanks was still being increased (by installing larger caliber or longer barreled guns). Plans were drawn up to use more powerful armament in all tanks and guns.

The Pz. Kpfw. IV was the most important tank in the German army for a long time. (Photo: Federal Archives)

From year to year, more and more armored vehicles were equipped with cannons, the movement of which in the horizontal plane was restricted. These measures were supported by infantry and artillery formations, but encountered resistance from the armored forces themselves.

A light, full-fledged tracked vehicle, on which various guns and howitzers could have been installed, was about to go into production. It was intended to be used by self-propelled field artillery units.

The trend towards building larger and heavier tanks was almost completely stopped towards the end of the war. The design of vehicles with a mass of 150 and 200 tons, which had started in 1942-1943, progressed very slowly due to the lack of interest at the top.

The opinion prevailed among the ground forces and in the armored weapons industry that the Panzerkampfwagen *Tiger II (Königtiger)* was much more complex to manufacture due to its size and mass than its weapon value would have justified.

The development cycle of a German tank, from the development stage to the start of production, was around 2.5 years before the war and was reduced to around 15 months during the war.

The *Ferdinand / Elefant* self-propelled cannon – the first to be mass-produced

Combat vehicle with electric drive transmission. (Photo: Tank Museum)

The Hull

Looking at the hulls of modern German tanks, one might get the impression that they were designed with ballistics in mind. Flat [rolled] plate is used almost exclusively, and all faces are inclined at the greatest possible angle. Plates of all sizes are connected to each other by interlocking; mutual joints are additionally reinforced with special profiles.

In many cases this must have led to a significant increase in the production costs. There is currently no information on the extent to which such methods improved armor protection. [The American officer may have lacked information on this, but the conception resulted from very concrete considerations.
After the introduction of the IS tank series (Josef Stalin) with a 122 mm gun by the Russians, there was a sudden increase in projectile mass. Even if the projectile did not penetrate the armor, the explosive force was so great that it often led to the tearing of the welds - ed. author]

There is nothing to indicate that significantly thicker armor than that of the *Tiger II* armored vehicle was planned. The super-heavy tanks that were being designed had approximately 30% thicker plates compared to the *King* Tiger.

The drive

A move was made to replace petrol engines with air-cooled diesel engines. Such engines for vehicles weighing 15-20 tons should go into production in 1945. For larger vehicles, on the other hand, they were only just being developed, and there was still a long way to go before they were ready for series production.